UNIVERSITY OF
GRAD
1971-1972

VOLUME LXVII, NUMBER 4, October 1971

Bulletin of the University of Rhode Island. Published quarterly by the University of Rhode Island, Kingston, Rhode Island 02881. Second-class postage paid at Wakefield, Rhode Island.

UNIVERSITY OF RHODE ISLAND

GRADUATE SCHOOL BULLETIN

1971-1972

Table of Contents

5 Personnel

7 The University

13 Degree Requirements

17 Admission and Registration

21 Fees and Financial Aid

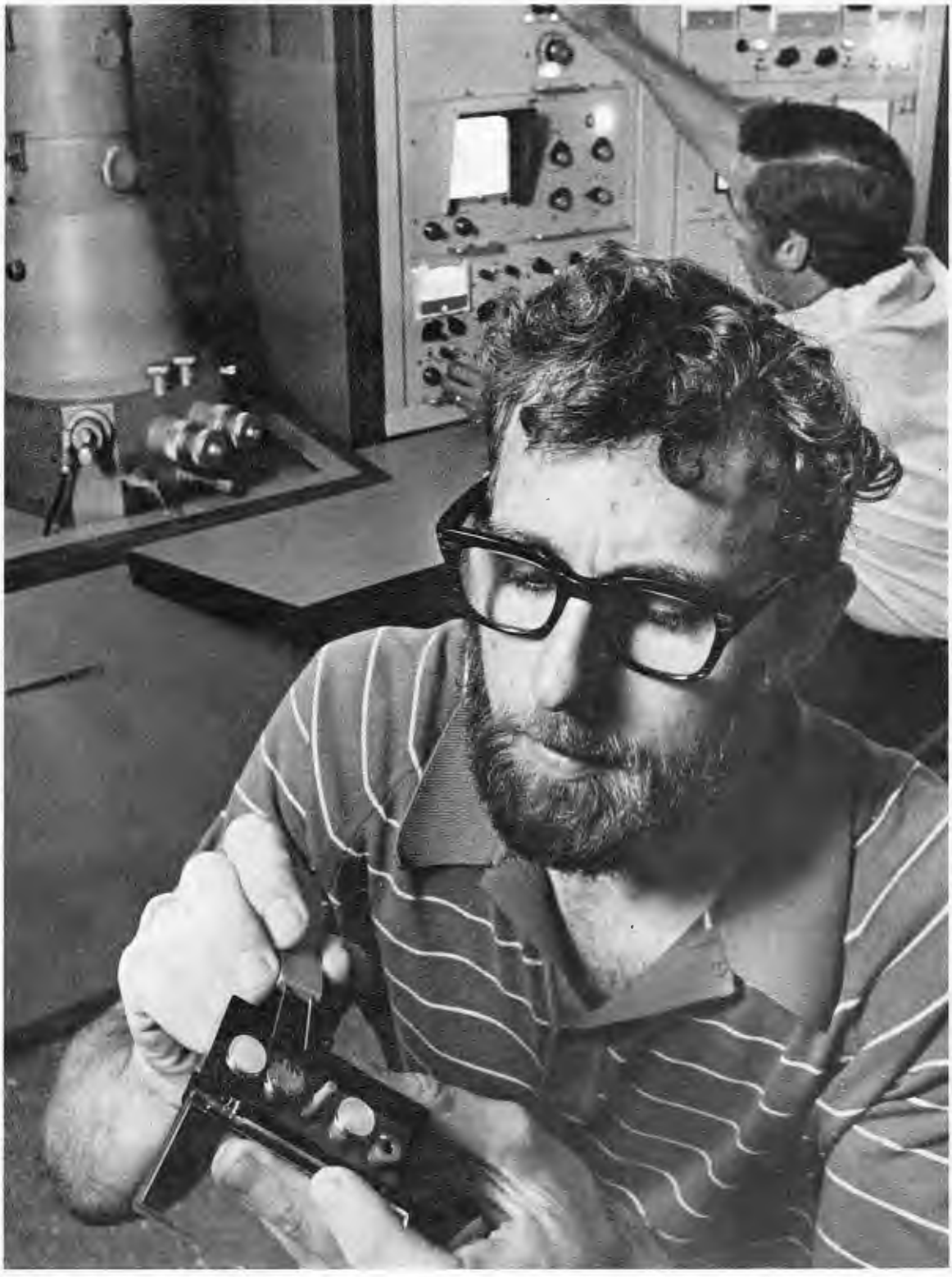
25 Graduate Programs

49 Courses of Instruction

114 Graduate School Calendar

116 Campus Map

118 Index



Personnel

GRADUATE SCHOOL

WILLIAM R. FERRANTE, Ph.D., *Dean*
ALOYS A. MICHEL, Ph.D., *Associate Dean*

Graduate Council 1971-1972

WILLIAM R. FERRANTE, *Chairman, ex officio*
JOHN A. BUONO, *Graduate Student Association President*
PAUL S. COHEN, *Arts and Sciences*
RALPH W. ENGLAND, *Arts and Sciences*
MARK D. GOULD, *Graduate Student Association*
AMOS HECKENDORF, *Graduate Student Association*
PHILLIP A. JONES, *Business Administration*
PATRICIA KELLY, *Home Economics*
ROBERT W. MACMILLAN, *Arts and Sciences*
EVERETT E. MCEWEN, *Engineering*
SHASHANKA S. MITRA, *Engineering*
THEODORE A. NAPORA, *Oceanography*
IRENE H. STUCKEY, *Resource Development*
JONATHAN S. TRYON, *Library Science*
JOSEPH G. TURCOTTE, *Pharmacy*
WILLIAM YOUNG, *Arts and Sciences*
One student member to be appointed by the dean.
One Arts and Sciences member to be elected.

ACADEMIC ADMINISTRATORS

WERNER A. BAUM, Ph.D., *President*
E. JAMES ARCHER, Ph.D., *Vice President for Academic Affairs*
JOHN A. KNAUSS, Ph.D., *Provost for Marine Affairs and Dean of the Graduate School of Oceanography*
HEBER W. YOUNGKEN, JR., Ph.D., *Provost for Health Science Affairs and Dean of the College of Pharmacy*
ROBERT LEPPER, JR., Ph.D., *Interim Dean of the College of Arts and Sciences*
RICHARD R. WEEKS, Ph.D., *Dean of the College of Business Administration*
LEWIS D. CONTA, Ph.D., *Dean of the College of Engineering*
BEVERLY DOWNING CUSACK, Ed.D., *Dean of the College of Home Economics*
BARBARA L. TATE, Ed.D., *Dean of the College of Nursing*
JAMES W. COBBLE, Ph.D., *Dean of the College of Resource Development*
EDWARD J. HUMESTON, JR., Ph.D., *Dean of the Graduate Library School*
FRANK L. WOODS, Ph.D., *Dean of the Summer Session*
GEORGE J. DILLAVOU, Ph.D., *Dean of the Division of University Extension*
NATHANIEL M. SAGE, JR., Ph.D., *Coordinator of Research*
GEORGE R. PARKS, M.A.L.S., *Librarian*

BOARD OF REGENTS

DENNIS J. ROBERTS, *Chairman*
EDWIN C. BROWN
JOSEPH L. BYRON
THOMAS A. DALTON
VERNON J. LISBON
RAE K. O'NEILL
ROBERT F. PICKARD
ROBERT A. RIESMAN
AMERICO A. SAVASTANO
FRED G. BURKE, Ph.D., *Commissioner of Education*

The University

The University of Rhode Island, a land-grant institution founded in 1892, is located in the village of Kingston, 30 miles south of Providence and six miles from the ocean. The faculty numbers about 800, and there are over 2000 graduate and 8000 undergraduate students enrolled. Approximately one-half of the graduate students are in full-time residence.

The University is made up of seven colleges and three schools: the Colleges of Arts and Sciences, Business Administration, Engineering, Home Economics, Nursing, Pharmacy, and Resource Development, the Graduate School, the Graduate Library School and the Graduate School of Oceanography.

The Division of University Extension in Providence enrolls about 7500 students in credit courses. The Master of Arts in English, the Master of Business Administration, and the Master of Public Administration degrees may be earned in the Division of University Extension as well as on the main campus.

Other campuses include the 2300-acre W. Alton Jones Campus, 20 miles from Kingston in West Greenwich, where research and conference facilities and a Youth Science Center are located; and the Narragansett Bay Campus, six miles from Kingston, for marine activities.

The University of Rhode Island is an Equal Opportunity employer.

ACCREDITATION

The accrediting agencies which have approved the quality of the course offerings of the University of Rhode Island include the American Association of Universities, New England Association of Colleges and Secondary Schools, University of the State of New York, Engineers Council for Professional Development, the American Chemical Society, the American Council on Pharmaceutical Education, the National League for Nursing, the American Association of Collegiate Schools of Business and the American Library Association. The University is also an approved member institution of the American Association of University Women, the National University Extension Association, and the Council of Graduate Schools in the United States.

Opposite: John H. Chafee Social Science Center under construction.

GRADUATE STUDY

The Dean of the Graduate School has primary responsibility for administering the policies and procedures relating to advanced study at the University of Rhode Island. Graduate School policy is made by the Graduate Faculty, acting through its delegate body, the Graduate Council which includes student members. Only the Dean or the Graduate Council may grant exceptions to the regulations for graduate study.

Graduate study at the University was inaugurated in 1907 with the Master of Science degrees in chemistry and in engineering. The Master of Arts degree was first awarded in 1951 and in 1960 the University awarded its first Doctor of Philosophy degree. Graduate work for professional degrees was initiated in 1962 when the degree of Master of Public Administration was first awarded. Today, the master's degree is offered in over 65 areas of study and the doctorate in 23 areas.

GRADUATE DEGREE PROGRAMS

The University offers the programs of study listed below. Work in a combination of special areas is usually possible.

Master of Arts

*Economics
Education
*Educational Research
*Elementary Education
*Guidance and Counseling
*Reading Education
*Science Education
*Secondary Education
*Youth, Adult and Community Education
English
French
*Geography
History
*Philosophy
Political Science
International Relations
*Sociology
Spanish
*Speech Pathology and Audiology

Master of Science

*Accounting
*Animal Pathology
*Animal Science
*Bacteriology
Biochemistry
*Biophysics
Botany
*Business Education
*Chemical Engineering
Chemistry
*Child Development and Family Relations
Civil and *Environmental Engineering
*Computer Science
Electrical Engineering
Environmental Biology
*Environmental Health Sciences
*Experimental Statistics
*Food and Nutritional Science
*Food and Resource Chemistry
*Geology
*Home Economics Education
*Industrial Engineering
Mathematics
Mechanical Engineering and Applied Mechanics
*Medicinal Chemistry
*Nuclear Engineering
*Nursing
*Ocean Engineering (chemical, civil, electrical, mechanical)
*Oceanography
*Pharmacognosy
*Pharmacology and Toxicology
*Pharmacy
*Pharmacy Administration
*Physical Education (men and women)
Physics
*Plant and Soil Science
*Plant Pathology-Entomology
*Psychology (school)
*Resource Economics
*Speech Pathology and Audiology
*Textiles, Clothing and Related Arts
Zoology

Doctor of Philosophy

Biological Sciences
*Animal Pathology
*Bacteriology
*Biochemistry
*Biophysics
*Botany
*Food and Resource Chemistry
*Plant Pathology-Entomology
*Zoology
*Chemical Engineering
*Chemistry
*Economics, Marine Resources Option
*Electrical Engineering
Biomedical Engineering
*English
*Mathematics
*Mechanical Engineering and Applied Mechanics
*Ocean Engineering
*Oceanography
Pharmaceutical Sciences
*Medicinal Chemistry
*Pharmacognosy
*Pharmacology and Toxicology
*Pharmacy
Physics
*Psychology

Professional Degrees

†Master of Business Administration (M.B.A.)
*Master of Community Planning (M.C.P.)
*Master of Library Science (M.L.S.)
*Master of Marine Affairs (M.M.A.)
*Master of Public Administration (M.P.A.)

---

* Offered to qualified students from certain other New England states under the NEBHE agreement at in-state tuition rates. See page 21.
† Only the accounting option is offered under the NEBHE agreement.

GRADUATE LIBRARY SCHOOL

The Graduate Library School, located on the Kingston campus, offers studies leading to the professional degree of Master of Library Science. Some courses are offered in the Division of University Extension building in Providence. For description of the program and courses, see Library Science in the Graduate Programs and Courses of Instruction sections of this catalog. Specific inquiries concerning admission should be directed to E. J. Humeston, Jr., Dean, Graduate Library School, 74 Lower College Road, University of Rhode Island, Kingston, Rhode Island 02881.

GRADUATE SCHOOL OF OCEANOGRAPHY

The Graduate School of Oceanography offers instruction leading to the master's and doctor's degrees in oceanography with research emphasis on biological, chemical, geological or physical oceanography. A related program in ocean engineering is offered in the College of Engineering.

The 125-acre Narragansett Bay Campus, where the School is located, includes the State of Rhode Island's atomic reactor and federal laboratories devoted to the marine sciences. The campus on the west shore of Narragansett Bay is within easy reach of both bay and open ocean.

Major buildings include the Charles J. Fish Laboratory, the Claiborne Pell Marine Science Library, the Francis H. Horn Research Laboratory, a research aquarium, and a number of smaller laboratory and research facilities. The library contains a wide collection of books and periodicals on the marine sciences and reports of major oceanographic expeditions, making it one of the most complete marine science libraries on the east coast. The building also houses a remote computer console linked with the Computer Laboratory on the main campus. A marine experiment station is located on the saltmarsh at Jerusalem, Rhode Island. The School operates R/V *Trident*, a 180-foot research vessel used primarily for deep sea research, and a number of smaller craft.

The program in oceanography is described in the Graduate Programs section of this catalog. Inquiries requesting more specific information should be directed to T. A. Napora, Assistant Dean for Students, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island 02881.

RESEARCH

Active research programs are carried on in all seven colleges of the University and are supported by foundations, commercial firms, the United States government and the University. Specialized research is carried on in the several areas described below.

The Agricultural Experiment Station

The station, established in 1888, is concerned with basic and applied investigation in natural and human resources. This research aims to conserve and manage resources, improve the quality of environments, abate pollution and recycle waste materials, enhance rural environments, develop more rewarding home life, and support resource-using industry and business in the region. Research is conducted in food and resource chemistry, resource economics, plant and soil science, plant pathology-entomology, forest and wildlife management, animal science, and animal pathology. A strong orientation to estuarine and marine problems, and an interdisciplinary approach to resource research are station characteristics.

The Bureau of Government Research

The bureau was organized in 1960 to provide service to municipalities and to the state. The bureau maintains a municipal consulting service which assists Rhode Island communities in dealing with problems of governmental organization and administration. It has a publications program including a research series, an information series, and a monthly newsletter, and operates a program of conferences and awards. The bureau assists in the administration of the graduate program in public administration, and maintains a public administration library and an information service for local government units.

The Division of Engineering Research and Development

The division was established in 1942 to coordinate the research activities of the College of Engineering. It disseminates the results of basic or fundamental investigations; conducts applied research or development investigations, particularly those of assistance to individual firms in Rhode Island; provides opportunities for graduate students and highly qualified undergraduates to participate in research studies; and offers opportunities for members of the engineering faculty, through research, to keep abreast of advances in the profession. Facilities are available for research in the fields of chemical, civil, electrical, industrial, mechanical, materials, nuclear, environmental and ocean engineering.

THE LABORATORIES FOR SCIENTIFIC CRIMINAL INVESTIGATION

These laboratories provide instruction, research and service in the field of scientific criminal investigation. The laboratory staff works closely with the Rhode Island Attorney General's Office and provides technical consultation for various law enforcement agencies and special instruction and research in criminalistics.

MARINE RESEARCH PROGRAMS

A number of marine research programs are carried on at the University and are coordinated under the Provost for Marine Affairs. These include basic and applied research in the several areas of physical, chemical, geological and biological oceanography within the Graduate School of Oceanography.

The *Sea Grant College Program,* started in 1968 with funds from the Sea Grant College and Program Act of 1968, encompasses specialized marine research, education and public service projects in many departments of the University.

The *Marine Resources Program* fosters interdepartmental research contributing to the effective utilization and conservation of the marine environment and cooperates with state and local agencies.

With initial support from the Agency for International Development, the University in 1969 created the *International Center for Marine Resource Development* to assist developing countries in using food and other resources from the sea.

The *Law of the Sea Institute,* established in 1965, conducts summer conferences designed to elucidate legal and jurisdictional problems in ocean resource exploitation. It is administered through the University and directed by a board composed of specialists drawn from various parts of the country.

THE INSTITUTE OF ENVIRONMENTAL BIOLOGY

The institute is an administrative organization consisting of faculty members active in graduate training and research in botany, electrical engineering, forestry, oceanography, pharmacology, and zoology, and of adjunct faculty members in associated federal and private laboratories, who provide an interdisciplinary approach to problems in environmental biology.

THE RESEARCH CENTER IN BUSINESS AND ECONOMICS

The center, established in 1965, coordinates the research activities of the College of Business Administration. The center initiates, conducts, and services research activities of the faculty in the fields of accounting, business education and office administration, business law, economics, finance, insurance, management science, marketing management, organizational management and industrial relations, and production and operations management.

THE RHODE ISLAND WATER RESOURCES CENTER

This is the state center for research and training in all phases of water resources. Similar centers in each of the 50 states and Puerto Rico were established through Public Law 88-379 in 1964 and work cooperatively with the federal government in an effort "to assist in assuring the nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population." Principal investigators of projects need not be employed at the University.

THE UNIVERSITY LIBRARY

The library, centrally located on the campus, is a four-level, air-conditioned building designed to accommodate almost half a million volumes and to provide the most advanced facilities for study and research. The open-stack arrangement permits direct access to the collection of approximately 400,000 books, periodicals, documents, manuscripts, microfilms and microcards. Annual growth is about 26,000 volumes per year. Special collections are devoted to rare books, Rhode Island history, local authors and University history.

Specialized libraries are located in Pastore Chemical Laboratory and in the Pell Library of the Graduate School of Oceanography.

RESEARCH RESOURCES

The Computer Laboratory has an IBM system/360 model 50 with 512K of high speed core storage, 1024K of bulk core storage, disk storage units, magnetic tape, card and printer input/output devices, and an off-line plotter. Approximately 50 remote consoles are located in the Computer Laboratory, the Departments of Chemical, Civil, Electrical, Industrial, Mechanical and Ocean Engineering, the Graduate School of Oceanography, the Colleges of Business Administration and Pharmacy, and the Division of University Extension, as well as in Wheaton College and various high schools in the state. A PDP-9 computer with graphics display console, located in the Department of Electrical Engineering, is linked to the 360 system. The staff members of the Computer Laboratory, who are teaching faculty in the De-

partment of Computer Science and Experimental Statistics, develop and maintain programming systems and application programs, and provide consultation in numerical methods, statistical analysis, and computational techniques.

Computer graphics facilities, graphical input and output devices, are also located in the electrical engineering building. The chemical engineering building has an applied dynamics 32 PB analog computer, ultra-high pressure and high-pressure temperature equipment that permits study of solid state under pressures of up to 80 kilobars and temperatures up to 2000°C, and a nuclear laboratory including counting equipment, multichannel analyzers, and subcritical assembly. Other equipment includes an off-line incremental plotter, a major laboratory for research on photo-electronic imaging devices, optical properties of materials and micro-electronics, electromagnetically shielded rooms for biomedical research, a field station for radio-propagation research, a pressure chamber for the study of underwater soil samples, a newly-designed rotating basin for studying basic problems in oceanographic hydrodynamics, reverberant and anechoic rooms for airborne acoustics work, an X-ray spectrograph, a scanning electron microscope and an RCA electron microscope.

The University's research vessel, *Trident,* a 180-foot ship capable of working in all parts of the world's oceans, carrying a scientific party of 13 men and women, can work continuously at sea for 60 days and provides one of the largest laboratory areas of any United States research vessel. A 45-foot motor cruiser, *Gail Ann,* is part of the permanent fleet and a 40-foot dragger, *Billie II,* is chartered on a year-round basis for work in Narragansett Bay and Rhode Island Sound.

Students at the University have a research reactor and associated facilities available to them at the Rhode Island Nuclear Science Center, located on the Narragansett Bay Campus. Constructed and operated by the state of Rhode Island, this critical reactor is extensively used for research by many departments of the University. The reactor, designed for 5MW, is now operating at 2MW. A subcritical reactor is located on the main campus.

GRADUATE LIFE

Students find unique advantages at a University located in a small village in the heart of the northeastern Megalopolis. Cultural variety and compact size are combined in the state of Rhode Island, and other cultural centers are easily accessible. Boston is 80 miles to the north and New York City 160 miles southwest. Direct bus service to these cities, as well as to Providence and Newport, is available from the campus. The Kingston station of the Penn Central railroad is two miles away.

Services

The recreational and cultural facilities of the campus are open to graduate students, including use of the Memorial Union building. Facilities there include meeting rooms, lounges, bowling lanes, billiards, table tennis, the University Bookstore, cafeteria, and snack bar. Services include an information center, barber shop, bank, travel agency, laundry pickup station, Western Union office, record and art print libraries, and student pub serving wine and beer to students 21 years old and over.

Every effort is made to provide graduate students with opportunities for consultation and advice on matters of concern to them in their academic, extracurricular and personal lives. Descriptions of available services and facilities, including those associated with religious life, may be found in the *University Catalog*. Of particular interest to graduate students are the following: Career Planning and Placement, 80 Lower College Road; Counseling Center, Davis Hall; Health Service, Potter Building; Housing Office, Roger Williams Complex; International Student Affairs, Taft Hall; Religious Counselors, Memorial Union and Catholic Center; Student Aid Office, Davis Hall.

Services for the Disadvantaged or Handicapped

The Dean of the Graduate School, the Director of Career Planning and Placement, the Director of Counseling, and the Director of the (undergraduate) Special Program for Talent Development cooperate to provide information and guidance for economically and socially disadvantaged individuals seeking opportunities for graduate study at the University. Inquiries may be directed to any of these offices. A number of Department of Housing and Urban Development fellowships are available for members of minority groups accepted into the Master of Community Planning program.

Special counseling for physically, psychologically, or vocationally handicapped individuals is available from the Director of Counseling, Davis Hall.

Graduate Student Association

This organization is interested in both the academic and social aspects of graduate life. Officers and representatives of the association are elected

annually from the entire graduate student body and the association is represented on the Graduate Council. The association publishes a newspaper, *The Grad Side*.

There are also organizations for wives of graduate students and for students from foreign countries.

Living Accommodations

The University Housing Office maintains a list of off-campus rooms, apartments, and houses which may be rented by graduate students. For these the use of a car is desirable. A very limited number of apartments for graduate and married students is available on campus. For further information on housing, including current costs, interested students should contact the Director of Housing, Roger Williams Complex.

Dining services are available for graduate students and their guests at any of the University dining halls. The Ram's Den in the Memorial Union provides additional services. Students desiring University board must sign a semester contract based on a 15-meal week (three meals per day, Monday through Friday). Current costs and other specific information may be obtained from the Director of Dining Services, Lippitt Hall.

Army ROTC

A new two-year program has been designed to fill the needs of graduate students who have not taken Army ROTC during their undergraduate years. The United States Army offers the opportunity to earn commissions as second lieutenants after two years of on-campus ROTC training. The student attends a six-week basic summer camp after graduation with the bachelor's degree and completes the advanced ROTC course while attending graduate school.

Academic and Social Codes

Each student is a member of the University community with all the rights, privileges and responsibilities that go with such membership. The rights and privileges include full use of the educational opportunities and facilities offered on the campus. The responsibilities include those of making proper use of these facilities in order to progress educationally, of respecting the rights of others, and of knowing and obeying the rules and regulations developed by the University community for the good of the total membership.

The University expects that all course papers, theses and dissertations will be prepared and all examinations taken in conformance with accepted standards of academic integrity.

NOTICE OF CHANGE

Rules, regulations, charges, and fees set forth in this catalog are subject to change without notice.

Degree Requirements

Each advanced degree awarded by the University requires as a minimum the successful completion of a specified number of approved credits of graduate study at the University and the passing of prescribed examinations. Credit hours for a master's or doctoral degree may include formal course work, independent study, research, preparation of a thesis or dissertation, and such other scholarly activities as are approved by the candidate's program committee and the Dean of the Graduate School.

It is the student's responsibility to know the calendar, regulations and pertinent procedures of the Graduate School and to meet its standards and requirements. These are set forth in this catalog, the *Graduate Student Manual,* the *Statement on Thesis Preparation,* and other publications, all of which are available to graduate students at the Graduate School Office.

These documents govern both master's and doctoral degree programs. The manual gives detailed information on preparation of theses and dissertations, examination procedures, and responsibilities of major professors and program committees.

Students are advised to consult the *Statement on Thesis Preparation and Instructions for Thesis Defense* available in the Graduate School Office and the most recent edition of Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations* published by the University of Chicago Press.

The requirements immediately following are *general requirements* for all graduate students. *Specific requirements* for individual programs are itemized in the section on Graduate Programs.

PROGRAM OF STUDIES

All degree candidates are required to prepare a program of studies with the guidance of their major professors (for master's degree programs) or of their program committees (for doctoral programs) in accordance with the guidelines in the *Graduate Student Manual.* After the program has been approved by the major professor for master's degree candidates or program committee for doctoral candidates as specified in the manual, the program of studies is to be submitted for approval to the Dean of the Graduate School.

The purpose of the program of studies is to ensure that the student, at an early stage in his graduate study, organizes a coherent, individualized plan for his course work and research activities. It is expected that the successful completion of the student's program of studies will demonstrate that he has achieved the high level of competence required of graduate students in their respective fields.

COURSE NUMBERING SYSTEM

All graduate courses are now numbered at the 500-, 600-, and 900-levels (though not all 900-level courses carry graduate credit). Courses numbered at the 400-level are for advanced undergraduates, but may, with approval and to a limited extent, be accepted toward meeting degree requirements at the master's level. For doctoral candidates who have completed the master's degree in the same field or one closely related, all

program work must be at the 500- or 600-level. Candidates for the doctorate may receive up to 30 credits toward the minimum required for recent graduate work taken at other institutions if appropriate for the program and discipline.

SCHOLASTIC STANDING

Graduate work is evaluated by letter grades. Only grades of A and B carry graduate credit for courses below the 500-level. In 500-, 600-, and 900-level graduate courses only grades of A, B and C will be credited toward the degree. All grades earned, however, will remain on the student's record and, unless the courses were approved for no program credit prior to registration, will be included in calculating the student's scholastic average.

A grade of C or lower in courses numbered below the 500-level is considered a failing grade. In such cases of failure the course must either be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School. If a student receives more than one C in courses below the 500-level, his graduate status is subject to review by the Dean of the Graduate School.

Grades of D and F are failing grades in 500-, 600-, and 900-level courses and require immediate review of the student's status. Courses failed at this level must be repeated or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School.

The grades S (satisfactory) and U (unsatisfactory) will be used for courses of study involving research undertaken for the thesis or dissertation and for certain courses and seminars so designated. The letter I (incomplete) is used for excused unfinished work. Incomplete grades assigned to graduate students in May 1971 or thereafter may be removed within one calendar year by completion of the required work. If the grade of I (incomplete) is not removed within one calendar year, it will remain on the transcript but may not be used for program credit. Grades of S, U, and I are not included in the academic average.

For graduation an average of B (3.0 on a 4.0 scale) in all work is required, except for courses meeting entrance deficiencies or approved for no program credit prior to registration in the course. At any time when the student's record indicates unsatisfactory performance his status is subject to review. A student who fails to maintain satisfactory scholarship or to make acceptable progress in his program will be terminated as a graduate student.

MASTER'S DEGREE REQUIREMENTS

There are no major or minor area requirements for the master's degree. However, no degree can be awarded for the accumulation of credits without a planned program of study. Courses for the degree are expected to be concentrated in the candidate's field of interest and related areas to produce a well-developed and coherent program which will meet his special objectives.

Requirements for the master's degree must be completed within a period of five calendar years, or seven calendar years with special permission of the department and the Dean of the Graduate School if the study is done on a part-time basis. The master's degree may be earned either through full- or part-time study or by a combination of the two. Candidates must take at least 80 percent of the credits required for the degree at the University of Rhode Island.

Some departments offer both a thesis and a non-thesis option while others offer only one plan. Please refer to the chapter on Graduate Programs for specific information on each program. The general requirements for these options are as follows.

Thesis Option

The minimum requirements for a master's degree are: (1) The successful completion of 30 credits, including 6 thesis research credits. (2) At the discretion of the department, the passing of written comprehensive examinations toward the end of the course work. (3) The submission of an acceptable thesis and the passing of an oral examination in defense of the thesis. Four copies of the thesis prepared in accordance with Graduate School requirements must be submitted to the Graduate School Office. A statement on preparation of thesis is available from that office.

Non-thesis Option

Depending upon departmental requirements, some master's degrees may be earned without a thesis. The minimum requirements for a non-thesis master's degree program are: (1) The successful completion of a minimum of 30 credits. (2) Registration in advanced seminars, practicums, internships, or other experiences useful to the student's future professional career. (3) Registration in one course which requires a substantial paper involving significant independent study. (4) The passing of a written comprehensive examination toward the end of the course work. Some departments may also require a final oral examination.

Language

Although the Graduate School does not stipulate a language requirement for the master's degree, certain academic departments require proficiency in a foreign language.

PROFESSIONAL DEGREE REQUIREMENTS

Students should refer to the specific program requirements for professional degrees and consult with the appropriate dean or director.

DOCTOR OF PHILOSOPHY DEGREE REQUIREMENTS

The Doctor of Philosophy degree must be completed within seven years after passing the qualifying examinations or after first registering for work beyond the master's degree.

The requirements for the doctor's degree are: (1) The completion of a minimum of 72 credit hours of graduate study beyond the baccalaureate degree, of which a minimum of 42 credit hours must be taken at the University of Rhode Island. (2) Satisfying the residence requirement that the student must maintain full-time residence for at least two semesters, exclusive of summer sessions, while acquiring the last 42 credits for the degree. Residence is interpreted as full-time attendance on campus or in the Division of University Extension during a regularly scheduled semester. Study carried on elsewhere under a University adjunct professor or in a laboratory having University of Rhode Island affiliation may also qualify as residence. With the exception of faculty, graduate assistants, research assistants, and other employees of the University, no candidate for the doctorate may count, except by action of the Graduate Council, part-time study toward satisfying this residence requirement. (3) If required by his department, proficiency in one or more foreign languages and/or in an approved research tool. (4) The passing of a qualifying examination. (5) The passing of a comprehensive examination. (6) The completion of a satisfactory dissertation. (7) The passing of a final oral examination in defense of the dissertation. The department in which the student studies for the doctor's degree may or may not require a master's degree preliminary to, or as a part of, the regular course of study.

Qualifying Examination

This examination attempts to evaluate a student's competence for continuing in his chosen field and pertinent related fields at the doctoral level. For students who hold the master's degree, or who have completed 30 credits of appropriate work at another institution, the qualifying examination may be waived by the Dean of the Graduate School upon unanimous recommendation of the student's program committee and the acknowledgment of the department chairman. If the examination is not waived, it must be taken prior to the end of the student's first semester at this University.

Comprehensive Examination

The student shall pass, not earlier than one-half semester before and no later than ten months after the completion of his program of formal course work, the doctoral comprehensive examination.

The comprehensive examination consists of two parts: written, requiring a minimum of eight hours; and oral, requiring not more than two hours. The student, with the approval of his program committee, applies to the Graduate School to take the examination. The oral examination committee includes the student's committee and two additional members of the Graduate Faculty appointed by the Dean of the Graduate School. One of the additional members represents a field of study allied to that of the student's concentration. The candidate's major professor arranges for and chairs the examination. Unanimous approval by the examining committee is required for passing the comprehensive examination.

A candidate whose performance fails to receive unanimous approval of either examining committee may, upon the committee's recommendation, be permitted one reexamination in the part or parts failed, to be taken only after an interval of at least ten weeks.

Final Oral Examination

This examination is a defense of the dissertation and is open to all members of the faculty and, generally, to all students. The examination, usually two hours long, is conducted by an examining committee comprised of the candidate's program committee and two additional graduate faculty members appointed by the Dean of the Graduate School. One of the appointed members will be designated by the Dean to chair the examination.

Unanimous approval of the examining commit-

tee is required for passing. If the candidate does not perform satisfactorily, the committee may recommend one reexamination under stated conditions.

LANGUAGE AND/OR RESEARCH TOOL

Each department, in cooperation with the Graduate School, is authorized to formulate and to amend its own requirements and methods of testing for competency in foreign languages and/or research tools (such as computer science). The department may, in turn, delegate this responsibility to the program committee for each individual doctoral candidate.

THESES AND DISSERTATIONS

For the oral defense, a sufficient number of completed copies of the thesis or dissertation, in a form acceptable to each member of the examining committee and the Dean of the Graduate School, is required. After all changes and corrections have been made, four copies prepared in accordance with Graduate School and Library requirements must be submitted to the Graduate School Office. Four copies of an abstract, not to exceed 600 words, are also required. A statement on the preparation of theses is available from the Graduate School Office.

Admission and Registration

ADMISSION

Persons holding the baccalaureate degree and wishing to take graduate-level courses at the University may do so through admission to the Graduate School as degree candidates or as non-degree students.

Application forms may be obtained from the Dean of the Graduate School, University of Rhode Island, Kingston, Rhode Island 02881. Zip code should be included in the applicant's return address. Inquiries concerning particular degree programs or courses of instruction should be addressed to the appropriate department chairman.

Applications and credentials are to be submitted to the Dean of the Graduate School who, after obtaining the recommendation of the department concerned, notifies the applicant of either full or conditional admission, or rejection. Final decision rests with the Dean of the Graduate School.

General deadlines for receipt of applications and all supporting documents are April 15 for September or Summer Session admission, and November 15 for February admission. As is indicated in the Graduate Programs section of this catalog, certain programs admit students only for September and/or have earlier deadlines. There is no assurance that applications received after these dates will be processed in time for enrollment in the desired semester.

Foreign Applicants

Applicants from foreign countries must complete the Test of English as a Foreign Language (TOEFL) with minimum scores of 500 for science students and 550 for non-science students. All inquiries from foreign students concerning applications, fees, housing, etc., should be sent to the Director for International Student Affairs, Taft Hall.

Transfer Credit

Transfer credit may be requested for graduate work taken at other accredited institutions of higher learning. Such credits may not exceed 20 percent of the total credits required for the master's degree program or 30 credits in a doctoral program. The transfer work must have been taken at the graduate level and graded as B or higher, and must have been completed not more than five years prior to the date of request for transfer into a master's program (ten years for the doctoral program), and have a clear and unquestioned relavance to the student's program of study. The request for transfer credit must have the approval of the student's major professor and the Dean of the Graduate School. If transfer credit is desired for work taken elsewhere after a graduate student is enrolled at this University, *prior* approval must be obtained from the Dean of the Graduate School.

Degree Candidates

Applicants must forward to the Dean of the Graduate School two completed application forms, two official copies of transcripts of all previous college work, three letters of recommendation and scores in the appropriate nationally administered tests. Tests required for specific programs may be found in the Graduate Programs section of this catalog.

For acceptance on full status in the Graduate School, in addition to satisfactory test scores and references, applicants should have maintained an

undergraduate average of approximately B (3.0 on a 4.0 scale). Applicants with undergraduate averages below this level, but not less than 2.0, may be admitted to conditional status upon the submission of high test scores. Such persons will be admitted to full graduate standing upon the completion of the equivalent of one semester of full-time work with a grade average of B or better. No student may remain on conditional status for more than two consecutive semesters.

In certain cases, applicants who have been denied admission may be advised to take several courses in non-degree status (see below) to provide a basis for a later reconsideration of their applications. In such cases, these courses are usually regarded as entrance deficiencies and are not accepted for advanced standing within minimum-credit programs of study.

Non-degree Students

Non-degree students are those who desire registration with credit in courses during a regular academic year and who are not seeking an advanced degree. Non-degree students do not have the privileges regularly enjoyed by degree candidates. For example, their enrollment in courses is subject to the accommodation of degree candidates wishing to take those courses. No more than a total of 12 credit hours of work taken at the University of Rhode Island in non-degree status may be applied toward degree requirements if the student is later admitted to a degree program, and then only upon recommendation of the student's program committee and with the approval of the Dean of the Graduate School. Advanced standing for work taken at another institution must also be included within this limit as well as within those described above for transfer credit.

Applicants seeking admission in non-degree status must file the regular application for admission and submit the required transcripts. They need not, however, submit letters of recommendation or scores on nationally administered tests until such time as they may wish to apply for admission to a degree program.

REGISTRATION

The responsibility for being properly registered rests with the student. Each student must register and complete his registration within the time period announced by the University. The chairman of the student's major department will assign an adviser to assist the new graduate student in planning his program.

Registration for each semester consists of three separate procedures: registering for course selections, payment of fees, and obtaining a class program.

Registering for Course Selections

Students must obtain registration cards at the announced time and place. Currently enrolled students register in November for the spring semester and in April for the fall semester. It is the student's responsibility to make an appointment with his major professor and submit his completed cards to the Registrar during the registration period, according to the announced instructions.

New and transfer students will be instructed concerning registration procedures.

Payment of Fees

Arrangements must be made with the Bursar for complete payment of tuition and/or fees by the due date. Class programs will be issued only for those students who have registered for course selections, and satisfied payment requirements with the Bursar.

Class Programs

Students may not attend classes without class programs. These are issued prior to the first day of classes according to instructions from the Office of the Registrar.

Drop and Add

During the two week period after the beginning of classes (drop and add period), students may adjust their schedules after obtaining the class program. Courses may not be *added* after the drop and add period. Courses may be *dropped* without penalty or changed to audit until mid-semester. In any course dropped after mid-semester, the instructor must submit a final grade.

Change of Address

It is the responsibility of the student to complete a change of address form in the Office of the Registrar whenever a change is made in his local, campus, or mailing address.

Summer Session

Although many graduate-level courses are offered during the Summer Session, the University does not guarantee that any particular course will be offered. The availability of individual faculty members to supervise research or to participate in comprehensive examinations and examinations in defense of theses or dissertations during the Summer Session varies from year to year.

During the Summer Session, special arrangements must be made with both the Graduate School and the department for scheduling comprehensive examinations and thesis or dissertation defenses. Graduate students must make prior, individual arrangements for taking directed studies or special problems courses, which require the approval of the Dean of the Graduate School and the Dean of the Summer Session.

Continuous Registration

A graduate student is expected to complete his course work and research within the five-year time limit prescribed for the master's degree and the seven-year time limit for the doctorate. A student who has completed his course work and residence requirement is required to register and pay for Continuous Registration (CR) until his thesis or dissertation and all examination requirements are completed. A student must also be registered for either course work or CR during the semester in which he expects to complete all degree requirements. Upon application to the Dean of the Graduate School, the time limit for a degree program may be extended for such legitimate reasons as military service or serious illness. This request requires the endorsement of the student's major professor or department chairman.

Full-time and Part-time Students

The normal full-time registration is twelve credit hours of study during a regular semester. Minimum full-time registration is nine credit hours during a regular semester and six credit hours during a summer term. Full-time registration is required of all students holding fellowships, scholarships, and traineeships administered by the University. Students who do not meet the minimum full-time registration requirement are considered part-time students.

Off-campus Activity

Students who wish to register for credits to be counted toward a degree, and who will be earning these credits through off-campus activities such as research or independent study at a national laboratory, are required to obtain prior approval of the Dean of the Graduate School and to have these activities listed as part of their programs of study.

Intellectual Opportunity Plan (Pass/Fail Option)

To allow graduate students to venture into new areas of knowledge without fear that their scholastic average will suffer, the Graduate Council has approved the Intellectual Opportunity Plan. To be eligible for this option, the student's major professor or adviser must certify that the course or courses are outside the student's major field of study, are not entrance deficiencies, and are not specific requirements of, but are relevant to, the student's program. A maximum of four credit hours may be taken by the master's degree candidate and a maximum of eight credit hours, including any taken as a master's candidate, by the Ph.D. candidate.

Auditing

Courses may be audited with the approval of individual course instructors and by presenting an auditor's card secured from the Registrar. An auditor receives no course grade; consequently, an audited course does not count as part of the student's course load for registration purposes, and cannot count as work taken toward completion of residence requirements.

Library

Fees and Financial Aid

FEES

Charges and fees set forth in this catalog are subject to change without notice.

Tuition and fees vary according to whether or not the student is a legal resident of the state of Rhode Island and according to full-time or part-time enrollment. All charges are payable by the semester on receipt of the bill.

A Rhode Island resident must file with the Bursar a certificate of residence signed by the clerk of the Rhode Island city or town where he claims legal residence.

NEHBE Regional Student Program

Under provisions of a Regional Student Program, the University charges enrolled students from other New England states in specified programs of study the Rhode Island resident rates. This reciprocal agreement with other New England states applies only for programs which are not available in the student's own state university and which are indicated in the list of Graduate Programs on page 8. Specific information on who qualifies for each of the programs may be obtained from the Graduate School or from the New England Board of Higher Education, 20 Walnut Street, Wellesley, Massachusetts 02181.

Schedule of Fees

This schedule of fees is effective for the 1971-72 academic year and the 1972 Summer Session. The University reserves the right to revise its schedule of tuition and fees without notice.

Full-time, One Academic Year. Students registered for 9 or more credits are considered full-time and are charged the following fees.

Tuition	
Rhode Island residents	$630
Out-of-state residents	750
Graduate student assessment	20
*Medical insurance	13
*Student health fee (optional)	65
Registration fee	10
Admission application fee	10

Part-time, One Semester. Students registered for 8 credits or less are charged the following fees.

Tuition, per credit hour	
Rhode Island residents	$ 30
Out-of-state residents	35
Graduate student assessment	1
Registration fee	5
Admission application fee	10

Students maintaining continuous registration and registered for no credit are required to pay a registration fee of $30 per semester.

Summer Session

Tuition—all students, per credit hour	$ 25
Registration fee	
Rhode Island residents	15
Out-of-state residents	25

Division of University Extension

Tuition—all students, per credit hour	$ 25
Registration fee	7

* All full-time students are required to participate in the University's Student Medical Insurance Program unless they can give evidence of comparable coverage in another plan. This hospital plan has a $20 deductible clause. The $65 student health fee covers care in the University infirmary and is optional for graduate students at this time.

Additional Fees

Students may be asked to make key deposits and to cover laboratory and other incidental expenses for specific courses.

Master's degree candidates must pay a thesis-binding fee of $4 and doctoral candidates must pay a dissertation-binding and microfilming fee of $30. These fees are due before the candidate submits his dissertation for approval by the Graduate School. All degree candidates must pay a diploma fee of $10.

Remission of Fees

Remission of tuition and the registration fee is granted to holders of tuition scholarships, graduate assistantships and most fellowships and traineeships. This policy does not include graduate research assistants and associates whose stipends are larger than those of graduate assistants. The health insurance fee and the graduate student assessment are both excluded from this remission policy.

Refunds

Refunds of payments made or credits against amounts due to the University shall be made to students who officially withdraw according to the scale below. The attendance period in which withdrawal occurs is counted from the first day of registration and includes weekends and holidays.

First two weeks	80%
Third week	60%
Fourth week	40%
Fifth week	20%
After five weeks	No refund

FINANCIAL AID

There are several forms of financial assistance available to graduate students. To be eligible for any form of assistance, the student must first be admitted to the Graduate School. Detailed information (stipends, allowances, tenure, etc.) on the fellowships, scholarships, traineeships and assistantships described below is available from the Graduate School Office and is included in the *Graduate Student Manual.* Fellowships, traineeships, and scholarships are awarded by the Dean of the Graduate School to students selected from nominees submitted by department chairmen. Students are advised to request nomination for these awards by the chairman of the department in which they plan to study or are currently enrolled at the University.

Fellowships

Fellowships are awarded to graduate students in recognition of achievement and promise as scholars. They are intended to enable students to pursue graduate studies and research without rendering any service to the University. A fellow's stipend is not considered compensation, but a tax-exempt gift. Graduate fellows are required to be full-time students and may not engage in additional remunerative work without the specific approval of the Dean of the Graduate School.

Special Fellowships are supported by various industrial firms, private foundations and individuals, and are usually restricted to students in particular areas of study and research. The stipends and supplemental allowances of these fellowships are not uniform.

University of Rhode Island Graduate Fellowships are supported by the Graduate School. A fellowship provides a stipend of $3,000 for the academic year and the remission of tuition. This fellowship gives preference to promising students in recently established doctoral study programs where other fellowship support may not be available.

National Science Foundation (NSF) Graduate Traineeships are awarded to outstanding graduate students who are citizens of the United States. Trainees may be candidates for either the master's or the Ph.D. degree and reappointment may be made for up to two years for the master's degree and four years for the doctoral degree.

National Science Foundation (NSF) Summer Traineeships are restricted to students who have served as teaching assistants during the previous academic year. These fellowships allow full-time graduate study or research for eight to twelve weeks during the summer.

National Defense Education Act (NDEA) Graduate Fellowships are supported by the U.S. Department of Health, Education and Welfare under Title IV of the National Defense Education Act. To be eligible for appointment as an NDEA fellow, a candidate must certify that he intends to pursue a full-time course of study leading to the Ph.D. degree and that he is interested in a career of college or university teaching. He must have completed the baccalaureate degree with an overall average of B or better.

National Institutes of Health (NIH) Traineeships are awarded by the Public Health Service, through NIH, to candidates for the Ph.D. degree who can meet the eligibility requirements specified in the training grant proposal. Trainees have tuition and fees remitted by the University. Trainees are appointed by the Dean of the Graduate School upon the recommendation of the program director and

endorsement of the chairman of the department holding the training grant.

Public Health Service Predoctoral and Special Fellowships are provided to enhance the competence and increase the number of professional persons in the medical sciences and other health-related fields. These fellowships are awarded by the National Institutes of Health and by the Bureau of State Services Divisions of Nursing, Air Pollution, and Water Supply and Pollution Control. Applications for these fellowships are made directly to Career Development Review Branch, Division of Research Grants, National Institutes of Health, Public Health Service, Bethesda, Maryland 20014.

Graduate Assistantships and Graduate Research Assistantships

Assistantships are awarded to full-time graduate students to provide them with teaching and research training. Assistants may be required to provide service for up to 20 hours per week. Appointments are initiated by department chairmen. To be eligible for such an appointment, the student must first be admitted to the Graduate School. His application for the assistantship should be submitted to the department chairman by February 15. Appointments are announced about April 1.

Graduate Assistants assist, under supervision, with instructional and/or research activities of a department. Not more than ten hours per week will be in classroom contact. Graduate assistant stipends for the 1971-72 academic year range from $2600 to $3000, depending upon qualifications and experience. Increases are projected for 1972-73 subject to approval of the University budget. In addition, tuition and the enrollment fee are remitted for the academic year of the appointment. Students appointed as graduate assistants for the1971-72 academic year will be given a remission of tuition and enrollment fees for the 1972 Summer Session if they chose to enroll. This policy will not be continued beyond the 1972 Summer Session. Additional remuneration is given for any work done during the summer, although such work cannot be guaranteed.

Graduate Research Assistants are assigned to individual research projects sponsored either by the University or by an outside agency. On supported research contracts and grants, the graduate research assistant is judged to be employed on a half-time basis (for a 40-hour week). For this he receives a stipend ranging from $3150 to $4600 for nine months without remission of tuition and fees. Additional remuneration up to $2666 is given for any work done during the summer months.

Other Assistance

Tuition scholarships, which provide for the remission of tuition and enrollment fees, are awarded by the Dean of the Graduate School from University funds. These scholarships are awarded to qualified students demonstrating need of financial assistance.

Loans for qualified students are available under the National Defense Education Act. Additional information is available from the Student Aid Office in Davis Hall, which administers loans.

Veterans' benefits information may be obtained from the Counselor for Veterans, Office of the Dean of Students in Green Hall.

TRIDENT

Graduate Programs

ACCOUNTING

M.S., M.B.A.

GRADUATE FACULTY

Associate Professor Porter S. Wood, M.A. C.P.A., *chairman.* Professors George W. Lees, Ph.D., Brooks A. Sanderson, Ed.D.; Associate Professors Francis A. Bird, Ph.D., C.P.A., Ephraim P. Smith, Ph.D.; Assistant Professors Phillip A. Jones, Sr., Ph.D., Daniel J. Looney, Jr., J.D., C.P.A., Spencer J. Martin, Ph.D., Richard Vangermeersch, Ph.D., C.P.A.

MASTER OF SCIENCE

Admission requirements: undergraduate grade point average of 2.5 or above (scale of 4.0) and a score of 450 or above on the ATGSB examination for conditional admission, undergraduate grade point average of 2.7 or above and a score of 475 or above on the ATGSB examination for full admission.

Program requirements: from 30 to 60 credits depending upon undergraduate program. A thesis is optional but the candidate is required to take GBA 671 if he elects the non-thesis option.

All 500-, 600-, and 900-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

MASTER OF BUSINESS ADMINISTRATION

See Business Administration program.

AGRONOMY

See Plant and Soil Science program.

ANIMAL PATHOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Vance J. Yates, Ph.D., *chairman.* Professor Pei Wen Chang, Ph.D.; Assistant Professors Margaret Kimball, D.V.M., R. E. Wolke, Ph.D.; Adjunct Professors Ahmed H. Dardiri, Ph.D., Oscar C. Liu, D.M.Sc.

SPECIALIZATIONS

Pathogenesis of avian adeno and bovine herpes viral infections in cells, embryos, and in avian and mammalian hosts; recovery of viruses from inland estuaries, streams and ponds; the genetic bases for resistance to the avian leucosis complex; diseases of fish.

MASTER OF SCIENCE

Admission requirements: GRE and an undergraduate major in biological science with a concentration in animal science, bacteriology, botany or zoology; mathematics through introductory calculus; quantitative analytical chemistry; and one year of organic chemistry and physics.

Program requirements: thesis and BCH 581, 582; APA 501, 502, 534, 536; BAC 432, 532, 541.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree not required.

Program requirements: courses listed under M.S. degree and APA 538; BPH 521; BAC 552, 544, 546.

ANIMAL SCIENCE

M.S.

GRADUATE FACULTY

Professor Lewis T. Smith, Ph.D., *chairman*. Associate Professors Clifford J. Cosgrove, M.S., Wayne K. Durfee, Ph.D., Bancroft W. Henderson, Jr., M.S., Raymond S. Hinkson, Ph.D., John J. Kupa, Ph.D., Thomas L. Meade, Ph.D., Lawrence E. Ousterhout, Ph.D., Arthur G. Rand, Jr., Ph.D.; Assistant Professors H. Glenn Gray, Ph.D., Richard I. Millar, M.S.

The department has research facilities for work with dairy cattle, sheep and poultry and game birds. The department participates in the Sea Grant Program; in the Food Science Program with the Departments of Food and Resource Chemistry, Resource Economics, Food and Nutritional Science, and Bacteriology; and in a program with the Department of Forest and Wildlife Management.

SPECIALIZATIONS

Food science; nutrition; physiology, genetics and management of livestock, poultry and gamebirds; and wildlife management.

MASTER OF SCIENCE

Admission requirements: GRE. A bachelor's degree in agriculture or a biological science is preferred.

Program requirements: thesis.

BACTERIOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Associate Professor Norris P. Wood, Ph.D., *chairman*. Professors Philip L. Carpenter, Ph.D., John M. Sieburth, Ph.D.; Associate Professors Paul S. Cohen, Ph.D., Chester W. Houston, Ph.D.; Adjunct Professor Victor J. Cabelli, Ph.D.; Adjunct Associate Professor Jan C. Prager, Ph.D.

SPECIALIZATIONS

Pathogenic bacteriology, immunology, microbial genetics, general microbiology, industrial microbiology, food and sanitary microbiology, phycology, bacterial physiology and metabolism, marine bacteriology, molecular biology, microbial ecology.

MASTER OF SCIENCE

Admission requirements: GRE and elementary courses in zoology, botany, and bacteriology; organic, inorganic, and quantitative analytical chemistry; introduction to biochemistry; physics; mathematics including calculus; at least one year of modern foreign language.

Program requirements: thesis; BCH 581, or 581 and 582; and 15-21 credits selected from BAC 412, 432, 495, 496, 533, 541, 552, 621; APA 534, OCG 567.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: satisfactory progress in graduate work permits admission without M.S. degree.

Program requirements: proficiency in calculus, physical chemistry, biochemistry, biophysics, statistics or biometry, genetics, and one foreign language; courses in related fields such as virology, mycology, and phycology. Students in the Molecular Biology Option will take research courses in bacteriology, biochemistry and biophysics.

BIOCHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor John L. Purvis, Ph.D., *chairman*. Associate Professors Joel A. Dain, Ph.D., George C. Tremblay, Ph.D., Spiros M. Constantinides, Ph.D.; Adjunct Professor Rupert P. Hammond, Ph.D.; Assistant Professor Robert G. Bell, Ph.D.

SPECIALIZATIONS

Mitochondrial metabolism and transport, comparative biochemistry of the cytochromes, biochemical aspects of endocrinology, neurochemistry, chemical embryogenesis of the nervous system and mechanisms of action of nervous tissue glycolipid synthetic enzymes, regulation of protein synthesis, pyrimidine metabolism, control of blood coagulation, control of enzyme-activity.

MASTER OF SCIENCE

Admission requirements: GRE with preference given to students with undergraduate majors in chemistry, biology or biochemistry.

Program requirements: thesis and BCH 541, 581, 582, two semesters of seminar (elected from BCH 531, 532, 533, 534), and two courses elected from BCH 601, 602, 611, 612.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: B.A., B.S., or M.S. degree.

Program requirements: courses listed under M.S. degree plus BCH 542, an additional two semesters of seminar (elected from BCH 531, 532, 533,

534) and one additional course elected from BCH 601, 602, 611, 612. Six credits of course work must also be taken from a selection provided by the department. These courses are selected to encourage the student to broaden his background and are not included for program credit. There is no language requirement.

SPECIAL FINANCIAL AID
Graduate teaching assistantships are reserved for advanced Ph.D. students. Research assistantships are available through research awards to individual faculty members.

BIOPHYSICS

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY
Associate Professor Norris P. Wood, Ph.D., *chairman.* Professor Harold W. Fisher, Ph.D.; Associate Professor Karl A. Hartman, Jr., Ph.D.

SPECIALIZATIONS
Electron microscopy, mammalian cell culture and tumor viruses, structure and functions of nucleic acid and ribosomes.

MASTER OF SCIENCE
Admission requirements: GRE and major in science or engineering; two semesters each in organic and physical chemistry and physics; mathematics through differential equations.
Program requirements: thesis and courses in biophysics, chemistry, physics, biology.

DOCTOR OF PHILOSOPHY (Biological Sciences)
Admission requirements: master's degree is not required.
Program requirements: BPH 521, 522, 526, 611, 621; a qualifying examination in physical chemistry and two selected from chemistry, physics, or biology. A master's degree may be accepted for one of the proficiency examinations. Comprehensive examination will require knowledge of the biophysics courses and one outside area. Two propositions outside the thesis area must be prepared and defended before submission of dissertation.

BOTANY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY
Associate Professor Roger D. Goos, Ph.D., *chairman.* Professors Luke S. Albert, Ph.D., Nestor E. Caroselli, Ph.D., Richard L. Hauke, Ph.D., Elmer A. Palmatier, Ph.D., Theodore J. Smayda, Ph.D., Richard D. Wood, Ph.D.; Assistant Professors William L. Halvorson, Ph.D., Paul E. Hargraves, Ph.D., John P. Mottinger, Ph.D.

SPECIALIZATIONS
Aquatic botany, mycology, plant development, plant ecology, plant pathology, plant physiology, plant taxonomy.

MASTER OF SCIENCE
Admission requirements: GRE advanced test and undergraduate major in the sciences. Candidates lacking undergraduate courses in organic chemistry, physics, mathematics through introductory calculus, and fundamental courses in biological sciences may be required to make up deficiencies without graduate credit.
Program requirements: thesis and BOT 581, 582.

DOCTOR OF PHILOSOPHY (Biological Sciences)
Admission requirements: master's degree not required.
Program requirements: one foreign language.

BUSINESS ADMINISTRATION

M.B.A.

GRADUATE FACULTY
Professor Richard R. Weeks, D.B.A., *dean,* College of Business Administration; Associate Professor Eugene M. Johnson, D.B.A., *assistant dean and director of M.B.A. program.*
Accounting: Associate Professor Porter S. Wood, M.A., C.P.A., *chairman;* Professors George W. Lees, Ph.D., Brooks A. Sanderson, Ed.D.; Associate Professors Francis A. Bird, Ph.D., C.P.A., Ephraim P. Smith, Ph.D.; Assistant Professors Phillip A. Jones, Sr., Ph.D., Daniel J. Looney, Jr., J.D., C.P.A., Spencer J. Martin, Ph.D., Richard Vangermeersch, Ph.D.
Business Law: Professor David G. Geffner, J.D.; Assistant Professor Austin Peck, J.D.
Finance and Insurance: Professor Marvin Pitterman, Ph.D., *chairman;* Professors Calvin H. Brainard, Ph.D., Roy G. Poulsen, Ph.D.; Assistant Professors G. Geoffrey Booth, Ph.D., John F. Fitzgerald, Jr., M.B.A., Robert A. Hershbarger, M.B.A., David Speicher, M.S.
Management Science: Professor Thomas E. Vollmann, Ph.D., *chairman;* Associate Professors Jeffrey E. Jarrett, Ph.D., Randolph F. C. Shen, Ph.D., Harold Sternbach, M.S.; Assistant Pro-

fessors Charles P. Armstrong, M.B.A., Frank S. Budnick, M.B.A., Albert J. Della Bitta, M.B.A., Richard Mojena, M.B.A., Wei Shih, Ph.D., Robert L. Zartler, M.B.A.
Marketing Management: Professor Aaron J. Alton, Ph.D., *chairman;* Associate Professors Beverly H. Bowman, M.S., Conrad R. Hill, Ph.D.; Assistant Professor David L. Loudon, M.B.A.
Organizational Management and Industrial Relations: Professor Norman Coates, Ph.D., *chairman;* Professor Carl W. Kaiser, Jr., Ph.D.; Associate Professors George deLodzia, Ph.D., Albert J. Hoban, J.D., Clark F. Murdough, M.A., Charles T. Schmidt, Ph.D.; Assistant Professors Louis R. Desfosses, Ph.D., Gary C. Raffaele, M.B.A.

The Master of Business Administration program is offered at the Kingston campus for full-time and part-time students and in the evening at the Division of University Extension in Providence for part-time students. Full-time work is preferred and encouraged. Candidates may begin the program in September or February of each year. Applications to the Dean of the Graduate School should specify the M.B.A. program and indicate on which campus the study is to be undertaken and the area of specialization.

SPECIALIZATIONS

Accounting, finance, management science, marketing management, organizational management and industrial relations.

MASTER OF BUSINESS ADMINISTRATION

Admission requirements: undergraduate grade point average of 2.5 or above (scale of 4.0) and a score of 450 or above on the ATGSB examination for conditional admission, undergraduate grade point average of 2.7 or above and a score of 475 or above on the ATGSB examination for full admission.
Program requirements: the non-thesis program (36 credit hours) can be completed in one calendar year by students who satisfy all foundation requirements. Students with no foundation work completed will take two calendar years (60 credit hours) to finish the program. ACC 611; ECN 690; FIN 641; GBA 671, 681; MGS 681, 682; MMG 651; OMR 631, 632; plus a six-credit sequence selected from ACC 618, 619; FIN 648, 649; MGS 683, 684; MMG 658, 659; OMR 638, 639.

All 500-, 600-, and 900-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

BUSINESS EDUCATION

M.S.

GRADUATE FACULTY

Associate Professor Kathleen F. Smith, M.Ed., *chairman.* Assistant Professors Clay V. Sink, Ph.D., Thomas E. Langford, Ed.D; Instructor Joseph F. Clark, M.S.

SPECIALIZATIONS

Administration and supervision of business education, use of audio-visual equipment and materials in business education, consumer education, innovations in teaching business education, survey of office and distributive occupations, cooperative education programs, business communications.

MASTER OF SCIENCE

Admission requirements: MAT and 21 undergraduate credit hours in accounting, finance, economics, marketing, management, statistics and business law. Candidates lacking undergraduate courses in business education may be required to make up deficiencies.
Program requirements: 30 credit hours without a thesis; including BED 524, 525, 526; six credits selected from BED 520, 522, 528; three credits selected from ECN 438, 463, 464, 503, 512; three credits selected from EDC 572 and BED 428; six credits in academic business subjects selected from accounting, business law, computer science, economics, finance, insurance, management science, and marketing management courses; plus three credits of graduate-level free electives numbered above 400.

All 500-, 600-, and 900-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

CHEMICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor A. Ralph Thompson, Ph.D., *chairman.* Professors Peter J. Gielisse, Ph.D., Anton F. Mohrnheim, D.Eng., G. David Shilling, Ph.D.; Associate Professors Niels Madsen, Ph.D., Kenneth H. Mairs, Met. E., Thomas J. Rockett, Ph.D., Vincent C. Rose, Ph.D., Ferdinand Votta, Jr., D.Eng.; Assistant Professors Stanley M. Barnett, Ph.D., Harold N. Knickle, Ph.D., Gerald C. Soltz, Ph.D.; Adjunct Assistant Professors Charles S. Sahagian, B.S., Leo A. Spano, M.S.

SPECIALIZATIONS

Adsorption, biochemical engineering, biomedical engineering, boiling heat transfer, catalysis, ceramics, corrosion, desalination, dispersion processes, distillation, fluid dynamics, heat transfer, ion exchange, kinetics, mass transfer, materials engineering, membrane processes, metal finishing, metal oxidation, metallurgy, nuclear technology, phase equilibria, pollution control, polymers, process dynamics, thermodynamics, water resources, X-ray metallography.

MASTER OF SCIENCE

Admission requirements: GRE and undergraduate major in engineering, chemistry, or physics. Undergraduate deficiencies in chemical engineering must be made up before proceeding with a full graduate program.
Program requirements: thesis (no qualifying examination) or non-thesis option (qualifying examination, comprehensive report and oral examination). CHE 501, 502.

DOCTOR OF PHILOSOPHY

Admission requirements: M.S. degree in engineering (may be waived for University of Rhode Island graduate students who pass qualifying examination with superior performance).
Program requirements: a candidate's program will be determined in consultation with his committee, and be based on his background and career goals. There is no general language requirement but a student's committee may require a foreign language or research tool which may be necessary for the student's program. In addition to an acceptable dissertation, a candidate must submit the manuscript of a paper, based on his research, suitable for transmittal to a technical journal. CHE 501, 502.

CHEMISTRY

M.S., Ph.D.

GRADUATE FACULTY

Professor Leon Goodman, Ph.D., *chairman*. Professors Paul I. Abell, Ph.D., Douglas L. Kraus, Ph.D., Scott MacKenzie, Ph.D., Bruno M. Vittimberga, Ph.D.; Associate Professors Richard D. Gonzalez, Ph.D., Wilfred H. Nelson, Ph.D., Douglas M. Rosie, Ph.D.; Assistant Professors Christopher W. Brown, Ph.D., Clair J. Cheer, Ph.D., James L. Fasching, Ph.D., Peter L. Hamlet, Ph.D., Louis J. Kirschenbaum, Ph.D., Harold Petersen, Jr., Ph.D., William M. Rosen, Ph.D.

SPECIALIZATIONS

Application of molecular orbital calculations to drug-receptor interactions, carbanion chemistry and ultraviolet spectra, catalysis, chelatable polymers, chemical ionization mass spectrometry, chemistry of heterocyclic molecules, chemistry of nucleosides and related sugars, electro-analytical chemistry, electrochemical kinetics, evaluation of molecular structure and dynamics by multinuclear nmr techniques, geometry of trivalent atoms and aspects of pyramidal inversion, gas chromatography, identification and structures of intermediates in air pollution reactions, infrared and Raman spectroscopy, ketones in thermal cycloaddition reactions, kinetics and mechanisms of reactions in solutions, kinetics of gas phase free radical reactions, mechanisms of free radical reactions, molecular structure of inorganic polymers using Rayleigh and Raman scattering, neutron activation analysis, non-classical carbanions, organic geochemistry, organic photochemistry, phase studies of alkali metal oxides, piezo-electric sorption devices, radiation chemistry, relaxation kinetics, solution chemistry of metals in unusual oxidation states, structures of liquid crystals, surface chemistry, synthesis and structure of theoretically interesting organic compounds, synthesis of transition metal complexes and organometallic compounds, trace metal analysis, X-ray crystallogic approaches to the solution of chemical problems.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test, and ACS placement examinations in analytical, inorganic, organic and physical chemistry. Preference is given to candidates with undergraduate majors in chemistry or chemical engineering with mathematics through calculus.
Program requirements: for thesis option (30 credit hours), CHM 641, 642 and thesis; for non-thesis option (36 credit hours), CHM 641, 642, 651, 652.

DOCTOR OF PHILOSOPHY

Admission requirements: preference is given to candidates with undergraduate majors in chemistry or chemical engineering with mathematics through calculus.
Program requirements: language; reading proficiency in one foreign language (French, German or Russian) or a research tool (computer science).

CHILD DEVELOPMENT AND FAMILY RELATIONS

M.S.

GRADUATE FACULTY

Professor George T. Fitzelle, Ph.D., *acting chairman.* Professor Russell C. Smart, Ph.D.; Associate Professor Mollie S. Smart, Ph.D.; Assistant Professor Renuka Sethi, Ph.D.

SPECIALIZATIONS

Preschool education, parent education, personality development.

MASTER OF SCIENCE

Admission requirements: GRE and 18 undergraduate credit hours distributed among at least three of the following areas: child development and family relations, psychology, sociology, biology, education.
Program requirements: thesis (30 credit hours) or non-thesis (36 credit hours) option.

CIVIL AND ENVIRONMENTAL ENGINEERING

M.S.

GRADUATE FACULTY

Associate Professor Everett E. McEwen, D.Eng., *chairman.* Professors Henry Campbell, M.S., Vito A. Nacci, M.S.; Associate Professors Francis H. Lavelle, M.Eng., Kendall Moultrop, M.S., Calvin Po-Chuen Poon, Ph.D.; Assistant Professors Pen Jeng Fang, Ph.D., Alan S. Marcus, Ph.D., Donald L. Sussman, Ph.D., Mian-Chang Wang, Ph.D., Gerald Zamost, Ph.D.

SPECIALIZATIONS

Environmental engineering (air pollution, solid waste disposal, water and waste-water treatment); soil mechanics (soil mechanics and foundations, deep-ocean sediments); structural engineering (emphasis on numerical and matrix methods of analysis).

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in civil or environmental engineering. Candidates in related fields of engineering or the sciences may be accepted with the possible addition of prerequisite courses.
Program requirements: thesis or non-thesis option. CVE 301, 302; and a minimum of two courses taken outside the department.

COMMUNITY PLANNING AND AREA DEVELOPMENT

M.C.P.

GRADUATE FACULTY

Assistant Professor Howard H. Foster, Jr., Ph.D., *director.* Professor Arthur D. Jeffrey, Ph.D.; Associate Professors Charles E. Downe, C.E., John W. Grifalconi, B.C.D., Dieter Hammerschlag, M.C.P.; Assistant Professors Richard O. Brooks, LL.B., Arnold D. Nadler, M.R.P.; Instructor Douglas Johnson, M.C.P.; Adjunct Professors Demetrius S. Iatridis, Ph.D., Glenn R. Kumekawa, M.A.

SPECIALIZATIONS

Planning administration; urban design; advocacy planning; planning methods and techniques; land use planning; regional and area planning; urban renewal; comprehensive social, economic and physical community programming; regional analysis and development planning; and environmental health planning.

MASTER OF COMMUNITY PLANNING

Admission requirements: GRE; undergraduate background in the social sciences, architecture, landscape architecture, engineering or geography preferred. Students are not admitted for February matriculation and part-time students are admitted only under very unusual circumstances.
Program requirements: thesis (60 credit hours); CPL 411, 603, 604, 611, 612, 621, 622, 631, 641, 661; summer internship or equivalent professional experience. The two-year program of 60 credit hours is distributed as follows: Seminar in Contemporary U.S. Environment, 16 credits; Planning Problems Studios, 18 credits; Introduction, Law, Methodology, Theory, 9 credits; electives and thesis, 17 credits. Students normally take 15 credits per semester.

SPECIAL FINANCIAL AID

U.S. Department of Housing and Urban Development Fellowships; fellowships for members of minority groups.

COMPUTER SCIENCE

M.S.

GRADUATE FACULTY

Professor William J. Hemmerle, Ph.D., *chairman.* Professors Peter F. Merenda, Ph.D., Lewis T. Smith, Ph.D.; Associate Professors Edward J. Carney, Ph.D., William D. Lawing, Ph.D.; As-

sistant Professors Leonard J. Bass, Ph.D., Frank M. Carrano, Ph.D., R. Choudary Hanumara, Ph.D., David E. Tetreault, B.S., Nelson H. Weiderman, Ph.D.

SPECIALIZATIONS
Algorithm theory and development, programming languages and linguistics, statistical computations, simulation, information retrieval, real time systems, time sharing systems, error analysis, data reliability, automata theory, artificial intelligence, information processing systems.

MASTER OF SCIENCE
Admission requirements: bachelor's degree with a minimum of 18 credit hours in mathematics, statistics, or computer science including the equivalent of: MTH 141, 142 Introductory and Intermediate Calculus with Analytic Geometry; MTH 243 Calculus and Analytic Geometry of Several Variables; MTH 215 Introduction to Algebraic Structures; and CSC 410 Introduction to Computer Science and Algorithmic Processes. GRE-V and GRE-Q are required for admission and, where appropriate, GRE-advanced (related field of undergraduate work).
Program requirements: CSC 411 and either 412 or 413 are required of all M.S. candidates. Every student is also expected to complete 12 credits at the 500 level. Nine of these credits must be in computer science, in courses other than CSC 591, 592. The student will select at least six additional credit hours in supporting courses. A thesis is required.

ECONOMICS

M.A.

GRADUATE FACULTY
Professor Richard A. Sabatino, Ph.D., *chairman.* Professors Joel B. Dirlam, Ph.D., William Haller, Jr., Ph.D., Richard Hellman, Ph.D., Virgil Norton, Ph.D., Elton Rayack, Ph.D., Bernard Schurman, Ph.D.; Assistant Professors Walter Labys, Ph.D., Dennis Paulaha, Ph.D., Vinod Prakash, Ph.D., James L. Starkey, Ph.D.

SPECIALIZATIONS
Economic development, economic theory, industrial organization, international economics, money and banking, public finance, econometrics, mathematical economics.

MASTER OF ARTS
Admission requirements: GRE and, normally, some undergraduate training in economics. Some training in mathematics and statistics is also desirable.
Program requirements: thesis or non-thesis option (30 credit hours). ECN 427, 428, and 512 or proof of proficiency. Non-thesis option requires registration in at least one course which requires a substantial paper involving significant independent study.

ECONOMICS (INTERDEPARTMENTAL)

Ph.D. Economics, Marine Resource Option

This interdepartmental program offers study in the economics of the utilization of marine resources. It is administered by a graduate economics faculty from several disciplines.

GRADUATE FACULTY
Professor Rayack, *chairman;* Assistant Professor Gates, *vice chairman.*
Economics: Professors William Haller, Jr., Ph.D., Elton Rayack, Ph.D., Richard A. Sabatino, Ph.D., Bernard Schurman, Ph.D., Assistant Professor Vinod Prakash, Ph.D.
Economics and Resource Economics: Professors Joel B. Dirlam, Ph.D., Virgil J. Norton, Ph.D.; Assistant Professor Dennis Paulaha, Ph.D.
Economic Development and Regional Planning: Professor Arthur D. Jeffrey, Ph.D.
Finance: Professors Marvin Pitterman, Ph.D., Roy G. Poulsen, Ph.D.
Resource Economics: Professors Harlan C. Lampe, Ph.D., Niels Rorholm, Ph.D.; Associate Professor Andreas Holmsen, Ph.D.; Assistant Professor John M. Gates, Ph.D.

DOCTOR OF PHILOSOPHY
Admission requirements: master's degree is not required.
Program requirements: ECN 512, 527, 528, 576, 627, 628; EST 520; and at least 15 credits from the following: REN 534, 543, 602, 634, 635; ECN 532, 543; EST 541. Additional courses may be selected from ECN 438, 463, 464, 515, 543, 552, 566, 595; REN 442, 577, 610, 675; FIN 410, 440; CSC 500; EST 532; or from appropriate offerings in industrial engineering, geography, oceanography, mathematics and political science.

As early as possible, students in this program should complete mathematics through calculus of several variables, or the equivalent.

The dissertation will be written on a special problem concerning marine resources or an associated industry, such as minerals, petroleum, fisheries, water utilization, transportation, recreation, and waste disposal.

EDUCATION

M.A.

GRADUATE FACULTY

Associate Professor Robert W. MacMillan, Ph.D., *chairman and coordinator of graduate studies.*
Audiovisual: Assistant Professor Rawland Cresser, Ph.D.
Educational Research: Assistant Professors Anthony Allen, Ph.D., John V. Long, Ph.D., Thomas Pezzullo, Ph.D., Jerome A. Schaffran, Ph.D., Lanny Soderberg, Ph.D., Richard Sullivan, Ph.D.
Elementary Education: Professor Thomas P. Nally, Ph.D.; Associate Professor William F. Kelly, Ed.D.; Assistant Professors Paul Jarman, Ed.D., Wilma I. Nagel, Ph.D., Charles Whitcomb, Ed.D.
Guidance: Professors John F. Quinn, Ph.D., S. Marvin Rife, Ph.D.; Associate Professor Alfred Pascale, Ed.D.; Assistant Professors Thomas Gunning, Ed.D., Peter Maynard, Ph.D.
Reading: Professor Robert C. Aukerman, Ph.D.; Assistant Professors Marguerite Bumpus, Ed.D., Marion L. McGuire, Ph.D.
Science Education: Associate Professor William Croasdale, Ed.D.; Instructors Joseph Caranci, M.A., Theodore Kellogg, M.A.
Secondary Education: Professor J. Edward Casey, Ed.D.; Associate Professors W. Chris Heisler, Ed.D., Francis X. Russo, Ph.D.; Assistant Professors Hilda Calabro, Ph.D., Guy DiBiasio, Ed.D., Abdulla R. Hagey, Ph.D.
Youth, Adult and Community Education: Associate Professor James D. Bromley, M.S.; Assistant Professor Donald McCreight, Ph.D.

Enrollment of foreign students is limited; a minimum TOEFL score of 600 is required.

The Master of Arts degree is offered in the following areas of study.

EDUCATIONAL RESEARCH

Admission requirements: MAT or GRE, Dopplet Mathematical Reasoning Test, teaching certificate, strong background in mathematics.
Program requirements: thesis or non-thesis option. EDC 503, 514, 529, 570, 571, 574; PSY 410, 434, 510, 550, 611; electives from computer science.

ELEMENTARY EDUCATION

Admission requirements: MAT and teaching certificate.
Program requirements: thesis or non-thesis option. EDC 503, 529; 18 to 24 credit hours of education electives and 6 credit hours taken outside education offerings.

GUIDANCE

Admission requirements: MAT and teaching certificate. Applications will be reviewed by April 15, October 15, and January 15 for admission in September, February, and June respectively. An interview is required.
Program requirements: thesis or non-thesis option. EDC 450, 529, 550; PSY 434; 21 to 24 additional education credit hours as planned with an adviser.

READING

Admission requirements: MAT and teaching certificate.
Program requirements: thesis or non-thesis option. EDC 424, 503, 529 or 541; PSY 434; 21 to 24 credit hours in education as planned with an adviser.

SCIENCE EDUCATION

Admission requirements: MAT, teaching certificate, and undergraduate major in science.
Program requirements: thesis or non-thesis option. EDC 503, 529; 12 to 18 credit hours of education electives and a minimum of 12 credit hours of science courses.

SECONDARY EDUCATION

Admission requirements: MAT, teaching certificate, and undergraduate major in a secondary education academic area.
Program requirements: thesis or non-thesis option. EDC 503, 529, 571; 9 to 15 credit hours of education electives and a minimum of 12 credit hours in the academic area presented for admission.

YOUTH, ADULT AND COMMUNITY EDUCATION

Admission requirements: MAT, teaching certificate, or a sound background in general education and the social sciences.
Program requirements: thesis or non-thesis option. EDC 505, 529, 580, 581, 583, 585, 588 and 589 (for non-thesis option). All courses are offered in late afternoon and/or evening.

ELECTRICAL ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Charles Polk, Ph.D., *chairman.* Professors James Grove, M.S., Gabriel Lengyel, Ph.D., Allen Lindgren, Ph.D., Shashanka S. Mitra, Ph.D., Sol Nudelman, Ph.D., Donald W. Tufts, Sc.D., Ralph Zirkind, Sc.D.; Associate Professors Hellmuth Etzold, Ph.D., James Hall, Ph.D., Alexander D. Poularikas, Ph.D., A. Ganesan Sadasiv, Ph.D., John E. Spence, Ph.D.; Assistant Professors John

Birk, Ph.D., James C. Daly, Ph.D., Paul G. Hubbell, Ph.D., Robert B. Kelley, Ph.D.; Adjunct Professors L. M. Biberman, B.S., J. Galejs, Ph.D., G. W. Goetze, Ph.D., B. Kazan, Ph.D., David Middleton, Ph.D., W. Stuermer, Ph.D.

SPECIALIZATIONS
Control of non-linear, time-varying and distributed parameter systems; stability theory; dynamics of biological systems; autoregulation of blood flow; visual tracking; study of neuron-like networks; computer graphics; communication and digital systems; data compression; electromagnetic wave propagation; geomagnetism; atmospheric electricity; ionospheric physics; plasma dynamics; quantum electronics; solid-state electronics; lattice dynamics; optical properties of materials; photoelectronic imaging devices; microelectronics; architectural and electro-acoustics; underwater acoustics; instrumentation; ocean electronic systems; optical transmission and data processing systems; remote sensing.

MASTER OF SCIENCE
Admission requirements: GRE and B.S. in electrical engineering, engineering science, physics, mathematics, or computer science. Preparation in related fields such as aeronautical, civil, chemical and mechanical engineering or in the life sciences may be acceptable.
Program requirements: thesis or non-thesis option. For the non-thesis option, ELE 501, 511 and at least three courses selected from ELE 505, 509, 531, 561, 605 or equivalent.

DOCTOR OF PHILOSOPHY
Admission requirements: GRE and M.S. degree or equivalent in electrical engineering, engineering science, physics, mathematics or computer science.
Program requirements: for the comprehensive examination, background in several of the following areas is required—linear and non-linear systems, communication and control systems, design of digital systems, electromagnetic theory and solid state physics. Most students find it essential to become thoroughly familiar with the application of digital computer techniques. Dissertation research makes use of major, modern laboratories in the listed areas of specialization.

ENGLISH

M.A., Ph.D.

GRADUATE FACULTY
Professor Jordan Y. Miller, Ph.D., *chairman;* Professor Allan MacLaine, Ph.D., *director of graduate studies.* Professors Thomas A. Gullason, Ph.D., Charles G. Hoffmann, Ph.D., Richard Neuse, Ph.D., Paul J. Petrie, Ph.D., Nancy A. Potter, Ph.D., E. Arthur Robinson, Ph.D., Warren D. Smith, Ph.D., Robert P. Sorlien, Ph.D.; Associate Professors Morris I. Goldman, Ph.D., James M. Marshall, Ph.D., Francis X. Mathews, Ph.D., Jules P. Seigel, Ph.D., Garold Sharpe, M.A., Edna L. Steeves, Ph.D., Ralph M. Tutt, Ph.D., Sidney H. White, Ph.D.; Assistant Professors Walter L. Barker, Ph.D., Walter Cane, Ph.D., Billy G. Collins, Ph.D., Mathilda Hills, Ph.D., Dorothy Jacobs, Ph.D., Helmuth W. Joel, Jr., Ph.D., Don R. Kunz, Jr., Ph.D., Marilyn J. Malina, Ph.D., Thomas H. McCabe, Ph.D., Philip T. Moreau, M.A., Clare M. Murphy, Ph.D., R. B. Reaves, Ph.D., Eric T. Schoonover, A.M., Tom H. Towers, Ph.D.; Instructors Wilfred P. Dvorak, M.A., William Mensel, M.A., David Titus, M.A.

SPECIALIZATIONS
For the M.A., American literature, English literature, comparative literature, literary criticism; *for the Ph.D.,* library resources are best suited for dissertation work in late Medieval and Renaissance English literature (including drama to 1642), English literature of the nineteenth century, American literature before 1900, English and American literature since 1900.

MASTER OF ARTS
Admission requirements: GRE and a minimum of 21 credits in English with a B-plus average in all English courses.
Program requirements: thesis; or for non-thesis option, two 600-level seminars and comprehensive examinations in three fields.

DOCTOR OF PHILOSOPHY
Admission requirements: GRE with advanced test and M.A. in English or equivalent. Early application is desirable due to limitation on enrollment.
Program requirements: reading knowledge of one foreign language is required, unless such requirement is waived by the program committee in consultation with the chairman of graduate studies.

ENVIRONMENTAL BIOLOGY

The Institute of Environmental Biology provides and interdisciplinary approach to graduate training and research. Programs are designed to produce environmental biologists trained in depth in one academic discipline, but equipped to cross the usual boundaries between disciplines and cope with the larger problems of man and his environment.

Qualified students may become candidates for advanced degrees in the Departments of Civil, Electrical and Mechanical Engineering; Botany; Food and Nutritional Science; Pharmacology; and Zoology; and in the Graduate School of Oceanography. Students must meet all requirements of their respective departments and colleges, and of the Graduate School, but it is expected that their programs of study will be interdisciplinary in nature and be supervised by an interdepartmental faculty committee. Degree requirements are listed under the degree-granting departments. Traineeships, funded by the National Institutes of Health, are available for predoctoral candidates in several departments.

The institute, which administers the program, consists of faculty members in botany, electrical engineering, food and nutritional science, forestry, mechanical engineering, oceanography, pharmacology, sanitary engineering and zoology; and of adjunct faculty members in several associated federal laboratories. Information is available from chairmen of the degree-granting departments or from Professor C. Robert Shoop, Ph.D., *director,* Institute of Environmental Biology.

ENVIRONMENTAL HEALTH SCIENCES

An interdisciplinary program leading to a master of science degree in Environmental Health Sciences provides graduate training for persons interested in careers in laboratories of state departments of health or in those of federal agencies. Graduates of programs in several areas of biological, physical and health sciences, or in engineering who have developed an interest in public health should, in most cases, have the necessary prerequisites. The student's course of study is planned by an interdepartmental faculty committee and includes work in air pollution, sanitation, food microbiology and chemistry, and public health law and administration. Information is available from the director of the program, Chester W. Houston, Ph.D., Department of Bacteriology and Biophysics.

EXPERIMENTAL STATISTICS

M.S.

GRADUATE FACULTY

Professor William J. Hemmerle, Ph.D., *chairman.* Professors Peter F. Merenda, Ph.D., Lewis T. Smith, Ph.D.; Associate Professors Edward J. Carney, Ph.D., William D. Lawing, Ph.D.; Assistant Professors Leonard J. Bass, Ph.D., Frank M. Carrano, Ph.D., R. Choudary Hanumara, Ph.D., David E. Tetreault, B.S., Nelson H. Weiderman, Ph.D.

SPECIALIZATIONS

Experimental design, survey design, multivariate methods, statistical computations, time series analysis, sequential methods, nonparametric methods.

MASTER OF SCIENCE

Admission requirements: bachelor's degree with credits in mathematics, statistics, or computer science, including the equivalent of MTH 141, 142, Introductory and Intermediate Calculus with Analytic Geometry; MTH 243, Calculus and Analytic Geometry of Several Variables; MTH 215, Introduction to Algebraic Structures; CSC 201, Introduction to Computing. Six credits are also required from the following: MTH 451, Introduction to Probability and Statistics; MTH 452, Mathematical Statistics; and EST 411, 412, Statistical Methods in Research I and II. GRE-V and GRE-Q are required for admission and, where appropriate, GRE-advanced (related field of undergraduate work).

Program requirements: six credits from MTH 451, 452, and EST 411, 412. The candidate must complete both sequences, but a maximum of six hours in these courses may be applied as program credit. Every student is also expected to complete at least twelve credits at the 500 level or above and nine of these credits must be earned in courses in experimental statistics, exclusive of EST 591, 592. The student will select, with the approval of his program committee, at least six additional credit hours in elective courses. A thesis is required.

FINANCE

For interdepartmental Ph.D. degree program, see Economics, Marine Resources Option.

FOOD AND NUTRITIONAL SCIENCE

M.S.

GRADUATE FACULTY

Professor Henry A. Dymsza, Ph.D., *chairman.* Associate Professor Spiros M. Constantinides, Ph.D.; Adjunct Professor Gerald Silverman, Ph.D.

The department participates in the Sea Grant Program, the AID-supported International Center for Marine Resource Development, the Institute of

Environmental Biology and the interdepartmental program in food science. Work beyond the M.S. degree may be developed with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS

Marine food preservation, food enzymology, utilization of fish proteins, food safety and pathology, gnotobiology, human nutrition and dietetics, nutritional biochemistry and metabolism, marine and new food sources, nutrition of fish and marine food organisms, nutrition education, public nutrition programs, quantity food systems.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree with adequate preparation for the proposed area of study.

Program requirements: thesis, FNS 504 and graduate courses approved by department.

FOOD AND RESOURCE CHEMISTRY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Milton Salomon, Ph.D., *chairman.* Professors Clinton O. Chichester, Ph.D., George T. Felbeck, Jr., Ph.D., Charles E. Olney, Ph.D.; Associate Professors Arthur G. Rand, Jr., Ph.D., Kenneth L. Simpson, Ph.D.; Adjunct Associate Professor Gerald E. Zaroogian, Ph.D.

There is a close relationship in graduate study with the Departments of Biochemistry, Biophysics, Chemistry, Food and Nutritional Science, Animal Science, Oceanography and Plant and Soil Science.

SPECIALIZATIONS

Food biochemistry, soil biochemistry, pesticide chemistry, soil chemistry, plant biochemistry, chemistry of agricultural and marine products.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in agricultural science, a biological science, or chemistry, at least one year of organic chemistry.

Program requirements: thesis and advanced courses in biochemistry and chemistry.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: a master's degree is not required.

Program requirements: dissertation and advanced courses in biochemistry and chemistry.

FRENCH

M.A.

GRADUATE FACULTY

Associate Professor Ruth H. Kossoff, Ph.D., *chairman,* Department of Languages. Professors Lambert C. Porter, Docteur ès Lettres, Harold H. Waters, Ph.D.; Associate Professors Jean S. Hyland, Ph.D., H. Dorothy Rothschild, Ph.D.; Assistant Professors Joseph G. Morello, Ph.D., Constantin Toloudis, Ph.D.

SPECIALIZATIONS

French literature, linguistics.

MASTER OF ARTS

Admission requirements: GRE or MAT and 24 semester hours, or equivalent, of French.

Program requirements: thesis, eight 500-level courses and comprehensive examination; or for non-thesis program, ten 500-level courses and comprehensive examination.

GEOGRAPHY

M.A.

GRADUATE FACULTY

Professor Lewis M. Alexander, Ph.D., *chairman.* Professors Edward C. Higbee, Ph.D., Aloys A. Michel, Ph.D.; Assistant Professors James M. Havens, Ph.D., Richard R. Brand, Ed.D.; Instructor Russell B. Capelle, Jr., M.A.

SPECIALIZATIONS

Marine geography, political and economic geography, comparative urban processes and land utilization, meteorology and climatology, North America and the North Atlantic region, quantitative and cartographic methods.

MASTER OF ARTS

Admission requirements: GRE. The advanced examination in geography is *not* required, but candidates should have, or be prepared to make up without graduate credit, the equivalent of 12 credits of introductory work in physical geography (or earth science), cultural, economic, and political geography. Another 15 credits in related social or natural sciences are desirable, as are introductory courses in cartography and computer science.

Program requirements: thesis and, normally, GEG 421, 502, 591 or 592.

An interdisciplinary program involving 18 additional credits in geography, history, and political

science leads to a Graduate Certificate in North Atlantic Regional Studies awarded by the Dean of the Graduate School as an adjunct to the M.A. in geography.

GEOLOGY

M.S.

GRADUATE FACULTY

Professor J. Allan Cain, Ph.D., *chairman.* Associate Professor Eugene J. Tynan, Ph.D.; Assistant Professors John J. Fisher, Ph.D., Monty A. Hampton, Ph.D., O. Don Hermes, Ph.D.

SPECIALIZATIONS

Coastal geology (geomorphology, sedimentology); igneous and metamorphic petrology-geochemistry; palynology. Individual programs may include courses and/or research in conjunction with the Graduate School of Oceanography.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in science or engineering. By the end of the first year, students lacking an undergraduate major in geology will be required to demonstrate, through course work and/or a qualifying examination, satisfactory knowledge of geology and related fields.
Program requirements: thesis; written comprehensive examination in addition to defense of thesis.

HISTORY

M.A.

GRADUATE FACULTY

Professor James F. Findlay, Ph.D., *chairman.* Professors William D. Metz, Ph.D., Daniel H. Thomas, Ph.D.; Associate Professors J. Morton Briggs, Ph.D., Robert M. Gutchen, Ph.D., Chong S. Kim, Ph.D., Maury Klein, Ph.D., Robert G. Weisbord, Ph.D.; Assistant Professors Anthony T. Bryan, Ph.D., Burton G. Brown, M.A., Joel A. Cohen, Ph.D., Charles E. Daniel, Ph.D., Richard A. Roughton, Ph.D., Gino Silvestri, Ph.D., Sharon Strom, Ph.D., Gary J. Thurston, M.A.

SPECIALIZATIONS

American history; diplomatic history; East Asian, African, Black, and Latin American history; imperialism; history of science; modern English history; modern European history; state and local history.

MASTER OF ARTS

Admission requirements: GRE (advanced test desirable) and bachelor's degree with at least 24 credits in history. Majors in related fields may be admitted with permission of the department.
Program requirements: thesis option (30 credit hours) to include four courses at 500 level, at least one of which must be a colloquium and one must be a seminar; non-thesis option (30 credit hours) to include five courses at the 500 level, at least one of which must be a colloquium and two must be seminars. Both options require a four-hour written examination, and an oral examination. Two courses in a related field are recommended.

HOME ECONOMICS EDUCATION

M.S.

GRADUATE FACULTY

Associate Professor Patricia S. Kelly, Ph.D., *director.* Professor Beverly D. Cusack, Ed.D.; Associate Professor Doris E. May, M.S.; Assistant Professor Louise W. MacKenzie, M.S.

The M.S. in Home Economics Education is interdepartmental within the College of Home Economics. The graduate student's program is planned on an individual basis considering the student's needs and interests, past educational and professional experiences, and future goals. Home Economics Education will be emphasized with additional courses chosen from one of the following home economics subject matter areas: 1) management and consumer education, foods and nutritional science; textiles and clothing, and/or child development and family relations; or 2) selection of one or two courses from each of the areas listed above; plus 3) additional courses selected from related areas such as education, psychology, sociology, economics, business.

The Home Economics Education program also offers courses to meet the Rhode Island certification requirements for a permanent teaching certificate. Thirty-six credits or an M.S. are required within six years of receiving one's Provisional Secondary Certificate in Home Economics.

SPECIALIZATIONS

Curriculum development; leadership development for supervision and administration of home economics programs; interaction analysis; innovative practices in methods and teaching techniques.

MASTER OF SCIENCE

Admission requirements: B.S. or B.A. in home economics with certification for teaching; experience or interest in teaching home economics; GRE and GRE Advanced Test.

Program requirements: for thesis option (30 credits), thesis, research methods course, basic knowledge of statistics, four-hour written comprehensive examination, two-hour oral defense of thesis; *for non-thesis option* (36 credits), action research project, research methods course, four-hour written comprehensive examination, oral presentation of action research project.

HORTICULTURE

See Plant and Soil Science program.

INDUSTRIAL ENGINEERING

M.S.

GRADUATE FACULTY

Professor Charles F. James, Jr., Ph.D., *chairman.* Professor D. Edward Nichols, Ph.D.; Associate Professors William D. Lawing, Jr., Ph.D., Stanley Rubinsky, M.M.E.; Assistant Professors Michael H. Branson, Ph.D., David M. Shao, Ph.D., Edward R. Lawson, Ph.D.

SPECIALIZATIONS

Production systems, materials processing-metrology, control systems, operations research, applied statistics, quality control and reliability, inventory control, stochastic processes, industrial-ocean engineering.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test and B.S. degree in industrial engineering. An applicant with a B.S. degree in mechanical, civil, or chemical engineering, or in mathematics or computer science will be considered; generally, such applicants will be required to complete some deficiency courses.

Program requirements: thesis or non-thesis option. One course each in operations research and computer science, two courses in probability-statistics, or equivalent.

SPECIAL FINANCIAL AID

Part-time professional employment is available in local industries and hospitals.

INTERNATIONAL STUDIES

International studies are represented by international orientations in many graduate programs as well as by the specialized programs described below. The International Studies Committee is charged with the overall task of developing policy, coordinating programs, and monitoring the University's work in this area. It includes representatives of the Graduate School, the Graduate Student Association, the International Student Affairs Office, the Graduate School of Oceanography, the College of Business Administration, the College of Engineering, the College of Resource Development, the Law of the Sea Institute, the Master of Marine Affairs Program, and the Departments of Economics, Education, Geography, History, Languages, and Political Science in the College of Arts and Sciences.

Inquiries concerning international orientations available through various combinations of electives within existing degree programs may be addressed to the department in which the student plans to enroll or to Frank M. Pelton, Ph.D., *chairman,* International Studies Committee, c/o the Graduate School.

SPECIALIZATIONS

Master of Arts in Political Science with International Relations Specialization. The Department of Political Science offers over 20 courses in international relations and area studies enabling students to fashion programs suitable to their special interests. To insure an interdisciplinary approach, the department encourages students to take up to 12 credits of relevant course offerings in economics, history, geography, or sociology. For requirements, see Political Science.

Graduate Certificate Program in International Development Studies. A five-course, 15-credit program leading to a Graduate Certificate awarded by the Dean of the Graduate School is offered in each spring semester by the Departments of Economics, Geography, Political Science, and Resource Economics. The Department of Sociology and Anthropology also participates in certain aspects of this new program. Sponsored by the University's International Studies Committee and supported by the University's International Center for Marine Resource Development, this graduate certificate program is designed to provide a supplemental, interdisciplinary concentration on the problems and processes of modernization and international development. The program is open to holders of the master's degree (or its equivalent)

in one of the participating disciplines as well as to candidates for such a degree at the University of Rhode Island.

The program is functional in design. It is built around a core interdisciplinary seminar, two more specialized seminars or courses in political science and economics, and a directed studies course in which the student engages in individualized research under the guidance of an interdepartmental panel. This research course allows each student to pursue a topic of particular interest to him. In addition, the student chooses an elective course from a list of which at least four or five choices should be available in any semester. Thus, it is possible to complete the entire program in a single spring semester, a factor of importance to those on leave from other institutions or governmental and international agencies.

Requests for further information and for application forms should be directed to the Dean of the Graduate School. Initial inquiries should indicate in which of the above disciplines, and from which institution, the applicant holds the master's degree, or whether he is interested in pursuing the master's degree at this University concurrently with the graduate certificate program, and where his particular research interests lie. Such information will assist the administering committee in selecting an adviser for the student and in designing a program adapted to his needs.

For interdepartmental Ph.D. degree program, see Economics, Marine Resource Option.

Graduate Certificate in North Atlantic Regional Studies. Designed to take advantage of the University's location in a northeastern state with a strong tradition of involvement in maritime and naval affairs, and with strong commercial and cultural ties with Western Europe, this program is an adjunct to the M.A. degree in geography or in political science. It is open both to University of Rhode Island degree candidates in these departments and to those who have already received an equivalent master's degree from other institutions. Successful completion results in the award of the Graduate Certificate by the Dean of the Graduate School.

The program requires two core courses plus four electives. The core courses are GEG 245 and a directed study or research course in geography or political science in which the student prepares and defends a substantial paper under the direction of a faculty committee. The four electives may be chosen from GEG 441, 443, 543, 571; HIS 411, 418; PSC 301, 431, 464, 472, 513. Assistantships or scholarships are not available for participants in the Graduate Certificate Program as such, but may be held by students who are concurrently enrolled in the M.A. programs in geography or political science.

Additional information is available from the chairman of the Department of Geography.

LIBRARY SCIENCE

M.L.S.

The Master of Library Science program is accredited by the American Library Association.

Graduate Faculty

Professor Edward J. Humeston, Jr., Ph.D., *dean,* Graduate Library School. Associate Professors Daniel P. Bergen, Ph.D., Frances W. Chin, Ph.D.; Assistant Professors Lea M. Bohnert, M.A., James S. Healey, M.S. in L.S., Lucy V. Salvatore, M.S. in L.S., Stewart P. Schneider, M.S., Jonathan S. Tryon, M.S.

Specializations

Reference and readers' services, technical services, and service in public, school, college and university, and special libraries.

Master of Library Science

Admission requirements: MAT or GRE and the bachelor's degree with majors in the liberal arts or sciences. Students with professional degrees (education, nursing, engineering, etc.) may be admitted but will be urged to include in their programs six credit hours of studies outside of but related to library science.

Program requirements: thesis (30 credit hours) or non-thesis (36 credit hours) option. LSC 501 through 505 and one course selected from LSC 520, 521, 522, 523.

MARINE AFFAIRS

M.M.A.

Graduate Faculty

Professor Lewis M. Alexander, Ph.D. (geography), *director;* Professor John A. Knauss, Ph.D. (oceanography), *provost,* Marine Affairs; John Kenneth Hutchinson, M.M.A., *executive assistant to the director.* Professors Harlan C. Lampe, B.S. (resource economics), Nelson Marshall, Ph.D. (oceanography), Foster H. Middleton, Dr.Eng. (ocean engineering), Niels Rorholm, Ph.D. (resource economics), Herman Sheets, Dr.Tech.

Sci. (ocean engineering); Assistant Professor John J. Fisher, Ph.D. (geology).

This 30-credit program is for those persons interested in problems of evaluation, use and control of the marine environment. Normally, the work is completed in nine months of intensive, full-time resident study with considerable independent responsibility on work projects and substantial written work. It is administered by a committee from the Departments of Resource Economics, Geography, Geology, Ocean Engineering, Political Science, and the Graduate School of Oceanography.

SPECIALIZATIONS

Regimes for the deep seas, decision inputs for coastal zone regulation, jurisdictional requirements for pollution controls, criteria for deciding among competing uses for the continental shelf, applications of cost-benefit analysis to systems models for coastal decisions, implications of treating ocean basins as distinct regions, regulation of the high seas fisheries, impact of ocean engineering advances on the definition of the continental shelf, and legal problems of international scientific expeditions.

MASTER OF MARINE AFFAIRS

Admission requirements: GRE, MAT (in special cases), ATGSB, or LSAT; prior graduate degree or equivalent experience in marine areas. Applicants are admitted for September only.

Program requirements: non-thesis program. REN 514, GEG 571, OCE 500, OCG 401 or appropriate oceanography substitute, PSC 464, MAF 650.

SPECIAL FINANCIAL AID

A marine affairs fellowship up to $3,400 is available.

MATHEMATICS

M.S., Ph.D.

GRADUATE FACULTY

Professor V. Lakshmikantham, Ph.D., *chairman.* Professor Emilio O. Roxin, Ph.D.; Associate Professors Rodney D. Driver, Ph.D., Norman Hosay, Ph.D., Sol Schwartzman, Ph.D., Robert C. Sine, Ph.D., E. R. Suryanarayan, Ph.D., Ghasi R. Verma, Ph.D.; Assistant Professors Raymond Beauregard, Ph.D., Dilip K. Datta, Ph.D., Norman J. Finizio, M.S., Edward A. Grove, Ph.D., Gerasimos Ladas, Ph.D., James T. Lewis, Ph.D., Pan-Tai Liu, Ph.D.

SPECIALIZATIONS

Ordinary, functional, and stochastic differential equations, integral equations, control theory and differential games, probability and statistics, approximation theory, fluid mechanics, continuum mechanics, electrodynamics, topological dynamics, differential geometry, algebraic topology, ring theory, functional analysis, partial differential equations.

MASTER OF SCIENCE

Admission requirements: GRE (advanced test desirable).

Program requirements: 30 credit hours (or 24 plus thesis) including at least 15 credits in mathematics at the 500 level or higher and at least 6 additional credits in mathematics at the 400 level or higher. Recommended courses include: MTH 515, 516, 525, 535, 536, and 562.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE (advanced test desirable).

Program requirements: MTH 515, 516, 525, 535, 536, and 562, plus specialized courses and electives. Two languages chosen from French, German, Russian; or one of these and computer science as a research tool.

MECHANICAL ENGINEERING AND APPLIED MECHANICS

M.S., Ph.D.

GRADUATE FACULTY

Professor Frederick L. Test, Ph.D., *chairman.* Professors Donald Bradbury, S.D., George A. Brown, Sc.D., Lewis D. Conta, Ph.D., Rodger B. Dowdell, Ph.D., William R. Ferrante, Ph.D., Charles D. Nash, Ph.D., Hilbert V. Schenck, Jr., M.S., Frank M. White, Jr., Ph.D.; Associate Professors Frank J. DeLuise, M.S., Robert H. Goff, M.S., Warren M. Hagist, M.E., John P. Hatch, M.M.E., John Parker, M.S., Andrew Velletri, M.S., Mason P. Wilson, Jr., Ph.D.; Assistant Professors Thomas J. Kim, Ph.D., Richard C. Lessmann, Ph.D., William J. Palm, Ph.D.

SPECIALIZATIONS

Hydrodynamics, gasdynamics, magnetofluidmechanics, two-phase flow, turbulence, fluidics, flow instrumentation, heat transfer, thermodynamics, elasticity, plasticity, materials, vibration, fatigue failure and fracture mechanics, reliability of mechanical engineering systems, biomechanics, kine-

matics, dynamics, stability, systems analysis, controls, analog and digital computer simulation, thermal pollution.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test. B.S. degree in mechanical engineering, applied mechanics, or aerospace engineering or in a related field such as engineering science, civil engineering, applied physics, applied mathematics.

Program requirements: thesis, two advanced-level courses in mathematics (or one in mathematics and one in computer science), one course outside area of specialization.

DOCTOR OF PHILOSOPHY

Admission requirements: master's degree, GRE with advanced test may be required.

Program requirements: two advanced-level courses beyond M.S. in mathematics or computer science, one course outside area of specialization. Research tool or associated studies in two areas.

MEDICINAL CHEMISTRY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Howard W. Bond, Ph.D., *chairman.* Associate Professor Charles I. Smith, Ph.D.; Assistant Professors Elie Abushanab, Ph.D., Joseph G. Turcotte, Ph.D.; Part-time Professor Edward J. Modest, Ph.D.; Part-time Associate Professor Benjamin H. Pringle, Ph.D.

SPECIALIZATIONS

Design and synthesis of potential medicinal agents, including antihypertensives, antimalarials, antimetabolites, antitumor agents, and molluscicides; development of methods of drugs analysis; drug instabilities.

MASTER OF SCIENCE

Admission requirements: GRE, including advanced test in chemistry, and bachelor's degree in pharmacy, chemistry, or allied sciences.

Program requirements: thesis; physical chemistry and CHM 422, 425; MCH 443, 444, or equivalent; MCH 621, 622; one modern foreign language recommended.

DOCTOR OF PHILOSOPHY
(Pharmaceutical Sciences)

Admission requirements: master's degree in pharmacy, chemistry, or allied sciences or bachelor's degree in one of these with evidence of superior ability.

Program requirements: German; CHM 521, 522; primary emphasis in organic and medicinal chemistry or pharmaceutical analysis, and secondary emphasis in chemistry, biochemistry, pharmacology, physical pharmacy, or pharmacognosy.

NUCLEAR ENGINEERING

M.S.

GRADUATE FACULTY

Professor A. Ralph Thompson, Ph.D., *chairman.* Associate Professor Vincent C. Rose, Ph.D., *program coordinator.* Associate Professors Niels Madsen, Ph.D., Kenneth H. Mairs, Met.E.; Assistant Professor Harold N. Knickle, Ph.D.; Adjunct Associate Professor A. Francis DiMeglio, M.S.; Adjunct Assistant Professor Michael Doyle, B.S.

The program in nuclear engineering is administered by the Department of Chemical Engineering.

SPECIALIZATIONS

Boiling heat transfer; desalination, dosimetry, fluid dynamics, heat transfer, ion exchange, mass transfer, metallurgy, nuclear technology, reactor design and evaluation, shielding, spectrometry.

MASTER OF SCIENCE

Admission requirements: GRE and a bachelor's degree in engineering, physics, or mathematics.

Program requirements: thesis and at least 12 credits in nuclear engineering with other subjects chosen from mathematics, physics, chemistry, and other branches of engineering.

SPECIAL FINANCIAL AID

The nuclear engineering program has been approved for Atomic Energy Commission fellowships.

NURSING

M.S.

GRADUATE FACULTY

Professor Barbara L. Tate, Ed.D., *dean.* Professor Ruth Cumings, Ed.D.; Associate Professors Janet Hirsch, M.S., Elise Michael, A.M.

SPECIALIZATIONS

General nursing with teaching or administration.

MASTER OF SCIENCE

Admission requirements: MAT and a bachelor's degree from an NLN-accredited program with an upper division major in nursing.

Program requirements: 36 credit hours without thesis, including 21 credits in nursing which includes practicum, 3 credits in biological science, 6 credits in behavioral science, 6 elective credits related to functional area.

OCEAN ENGINEERING

M.S., Ph.D.

GRADUATE FACULTY

Professor Herman Sheets, Dr. Eng., *acting chairman*. Professors George A. Brown, Sc.D., Foster H. Middleton, Dr. Eng., Vito A. Nacci, M.S., Hilbert V. Schenck, M.S., Herman Sheets, Dr. Eng., Frank M. White, Jr., Ph.D.; Associate Professors Robert S. Haas, M.S., Tadeusz Kowalski, Ph.D., Vincent C. Rose, Ph.D.; Assistant Professors Lester LeBlanc, Ph.D., Mark Moffett, Ph.D., Gerald C. Soltz, Ph.D.; Adjunct Assistant Professor Frederick DiNapoli, Ph.D.

SPECIALIZATIONS

Desalination of sea water, nuclear energy applications, corrosion, physical properties of marine sediments, acoustic properties of sediments, finite amplitude acoustics, in-situ sediment measurements, sediment transport, coring techniques, bottom profiling and penetration; coastal and underwater structures, estuarine pollution, pollution abatement, waste disposal, turbidity measurements, mathematical modeling of estuaries; underwater acoustics, applications of information theory to underwater communications and data acquisition, turbulent boundary layer flow noise, underwater construction, guidance and control of underwater vehicles, digital processing of wave, current and thermistor data; dynamics of towed body shapes, design of undersea pressure vessels, inelastic behavior of buoyant materials, wave motion and current studies, drag reduction with polymer additives, buoy dynamics, scuba safety and work effectiveness, underwater tooling, hydrodynamics of floating and submerged bodies.

MASTER OF SCIENCE

Admission requirements: GRE and B.S. degree in any classical engineering field, mathematics, physics or geology.

Program requirements: thesis and three courses selected from OCE 561, 571, 587, 610; OCG 501; and at least 24 course credits in electives.

DOCTOR OF PHILOSOPHY

Admission requirements: M.S. degree and master's thesis in engineering, physics or equivalent; OCE 561, 571, 587, 610; OCG 501.

Program requirements: dissertation; one oceanography course and one advanced applied mathematics course; completion of 30 course credits beyond the master's.

SPECIAL FINANCIAL AID

Link Foundation Fellowship for M.S. candidate; fellowship grants from NSF, NASA, NIH and NDEA are available for highly qualified students.

OCEANOGRAPHY

M.S., Ph.D.

GRADUATE FACULTY

Professor John A. Knauss, Ph.D., *dean*, Graduate School of Oceanography; Assistant Professor Theodore A. Napora, Ph.D., *assistant dean for students*. Professors Frank T. Dietz, Ph.D., Robert L. McMaster, Ph.D., Nelson Marshall, Ph.D., David M. Pratt, Ph.D., Saul B. Saila, Ph.D., John McN. Sieburth, Ph.D., Theodore J. Smayda, Dr. Philos., Lucian Sprague, Ph.D., Melvin E. Stern, Ph.D., Norman D. Watkins, Ph.D., Howard E. Winn, Ph.D.; Associate Professors Robert A. Duce, Ph.D., H. Perry Jeffries, Ph.D., James P. Kennett, Ph.D., Dale C. Krause, Ph.D., Michael E. Pilson, Ph.D., Akella N. Sastry, Ph.D., Jean-Guy Schilling, Ph.D., Wilton Sturges, III, Ph.D.; Assistant Professors Kern Kenyon, Ph.D., Dana Kester, Ph.D., Richard B. Lambert, Ph.D., Scott W. Nixon, Ph.D., James G. Quinn, Ph.D., and Elijah Swift, V, Ph.D.; Adjunct Professors Jelle deBoer, Ph.D., Ronald Eisler, Ph.D., Gilles LaRoche, Ph.D., Donald Phelps, Ph.D., David M. Shaw, Ph.D.

SPECIALIZATIONS

Biological, chemical, geological, and physical oceanography.

MASTER OF SCIENCE

Admission requirements: GRE (verbal, quantitative and advanced sections) and bachelor's degree (B average) in some field of the natural sciences or engineering. Applicants are admitted for September only. Due to limits on enrollments, applications should be completed by February 15.

Program requirements: thesis; OCG 501, 521, 540, 561, 695; participation in a regular ocean research cruise.

DOCTOR OF PHILOSOPHY

Admission requirements: GRE (verbal, quantitative and advanced sections); master's degree is not required, but bachelor's degree (B average) in some field of natural sciences or engineering. Applicants are admitted for September only. Due to limitations on enrollments, applications should be completed by February 15.

Program requirements: B grade in core courses, OCG 501, 521, 540, 561; six other course credits in oceanography at the 600 level (excluding problem and research courses and OCG 695); participation in regular ocean research cruise. Although there is no general language requirement, the individual student's major professor may require him to demonstrate ability in one or more foreign languages.

SPECIAL FINANCIAL AID

There is a limited number of research assistantships and traineeships for master's and doctoral candidates.

PHARMACOGNOSY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Associate Professor Leonard R. Worthen, Ph.D., *chairman.* Professor Heber W. Youngken, Jr., Ph.D.; Assistant Professors Yuzuru Shimizu, Ph.D., John T. Tashiro, Ph.D.

SPECIALIZATIONS

Biosynthesis of drug plant constituents; natural product chemistry; screening of natural products for physiologically-active agents, including materials from both land and marine sources.

MASTER OF SCIENCE

Admission requirements: GRE, bachelor's degree in pharmacy, chemistry, or biology.

Program requirements: thesis; PCG 445, 446, or equivalent; PCG 548, PCL 441, 442, or equivalent; CHM 425; BCH 581, 582.

DOCTOR OF PHILOSOPHY
(Pharmaceutical Sciences)

Admission requirements: master's degree in pharmacy, chemistry or biology or bachelor's degree in one of these with evidence of superior ability.

Program requirements: PCG 551, 552, 633, 634. A candidate entering the Ph.D. program with a bachelor's degree must also meet the M.S. program requirements.

PHARMACOLOGY AND TOXICOLOGY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor John J. DeFeo, Ph.D., *chairman.* Professor Harbans Lal, Ph.D.; Associate Professors David R. DeFanti, Ph.D., George C. Fuller, Ph.D.; Assistant Professor Gary Carlson, Ph.D.; Adjunct Associate Professor Sumner Robinson, Ph.D.; Adjunct Assistant Professors Yani Karkalas, M.D., Srecko Pogacar, M.D.

SPECIALIZATIONS

Behavioral, biochemical, cardiovascular, environmental, and marine pharmacology; toxicology.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree with science major.

Program requirements: thesis; mathematics through calculus; physical chemistry; one course in statistics; principles of pharmacology; PCL 441, 442, 521, 522.

DOCTOR OF PHILOSOPHY
(Pharmaceutical Sciences)

Admission requirements: bachelor's or master's degree with science major.

Program requirements: M.S. degree must be earned prior to Ph.D. if admission is granted without it.

PHARMACY

M.S., Ph.D. (Pharmaceutical Sciences)

GRADUATE FACULTY

Professor Robert J. Gerraughty, Ph.D., *chairman.* Professor George E. Osborne, Ph.D.; Associate Professors Walter T. Gloor, Jr., Ph.D., Anthony N. Paruta, Ph.D.; Adjunct Professor Louis P. Jeffrey, M.S.

SPECIALIZATIONS

Solubility phenomena, use of ultrasound to solve pharmaceutical problems, new methods of manufacture of pharmaceuticals, research in devising formulations, particle-size studies, biopharmaceutics.

MASTER OF SCIENCE

Admission requirements: GRE and bachelor's degree in pharmacy, a physical science or equivalent.

Program requirements: thesis; PHC 521, 522; one modern foreign language strongly recommended.

DOCTOR OF PHILOSOPHY
(Pharmaceutical Sciences)
Admission requirements: master's degree is not required.
Program requirements: PHC 521, 522.

PHARMACY ADMINISTRATION

M.S.

GRADUATE FACULTY
Associate Professor Norman A. Campbell, J.D., *chairman.* Associate Professors David H. Crombe, M.S., Michael D. Jacoff, Ph.D.

SPECIALIZATIONS
Development and utilization of pharmacy resources in health care systems involving the organization, financing, and delivery of health care services and goods.

MASTER OF SCIENCE
Admission requirements: GRE or MAT and bachelor's degree in pharmacy, social sciences, or allied fields.
Program requirements: thesis; PAD 599, 621, 622.

SPECIAL FINANCIAL AID
Fellowships from the American Foundation for Pharmaceutical Education.

PHILOSOPHY

M.A.

GRADUATE FACULTY
Professor David H. Freeman, Ph.D., *chairman.* Professors Wm. Oliver Martin, Ph.D., William Young, Th.D., B.Litt.; Assistant Professors Damian P. Fedoryka, Ph.D., John W. Hanke, Ph.D., Yong Choon Kim, Ph.D., Edward H. Pauley, Ph.D., John F. Peterson, Ph.D., Stephen D. Schwarz, Ph.D.; Instructor Donald J. Zeyl, M.A.

SPECIALIZATIONS
History of philosophy, philosophical logic, philosophy of religion, epistemology, metaphysics.

MASTER OF ARTS
Admission requirements: GRE.
Program requirements: thesis; German or French preferred.

PHYSICAL EDUCATION

M.S.

GRADUATE FACULTY
Associate Professor Maurice Zarchen, M.A., *chairman,* Associate Professor Raymond Nedwidek, Ed.D., *coordinator,* Department of Physical Education for Men; Professor M. Dorothy Massey, Ed.D., *chairman,* Physical Education for Women. Professors Paul F. Cieurzo, M.A., Carl V. Slader, M.Ed.; Associate Professors Jeannette E. Crooker, M.S., Roger K. Leathers, D.P.E., Barbara Mandell, M.A.; Assistant Professors Frank DelSanto, M.S., James McCormick, M.S., Richard Polidoro, D.P.E., Arthur Sherman, M.Ed., Robert Sonstroem, Ph.D.

The graduate program in physical education is open to both men and women.

SPECIALIZATIONS
Health education, recreation education, physical education for mentally retarded, and psychology of sport.

MASTER OF SCIENCE
Admission requirements: MAT or GRE with B.S. degree in physical education, health and physical education, or health education. In exceptional cases, a candidate without a physical education major, but with a strong emphasis in physical education is accepted.
Program requirements: thesis (30 credit hours) and PED 510, 530, 520, 550. For non-thesis option (33 credit hours), PED 510, 530, 520, and 591. Non-thesis option requires oral examination in addition to written comprehensives.

PHYSICS

M.S., Ph.D.

GRADUATE FACULTY
Professor Frank T. Dietz, Ph.D., *acting chairman.* Professors Werner A. Baum, Ph.D., Arthur L. Quirk, Ph.D.; Associate Professors J. Scott Desjardins, Ph.D., Kenneth L. Hartt, Ph.D., Stephen V. Letcher, Ph.D., Surendra S. Malik, Ph.D.; Assistant Professors Amar Choudry, Ph.D., Frank W. Cuomo, M.S., Charles Kaufman, Ph.D., Donald F. Kirwan, Ph.D., Jan Northby, Ph.D.

SPECIALIZATIONS
Neutron diffraction and scattering, hypernuclear physics, ultrasonic studies in liquid crystals and metals, underwater propagation of acoustic waves,

infrared spectrophotometry, propagation of waves in stochastic media, Brillouin scattering, liquid helium, few nucleon systematics, computational physics.

MASTER OF SCIENCE
Admission requirements: GRE advanced test and bachelor's degree with major in physics preferred.
Program requirements: thesis and PHY 520, 530, 570, 580. For non-thesis option, the student shall complete 36 course credits, with at least one course requiring a substantial paper involving significant independent study. Twelve of the course credits shall be in the 500- or 600-level physics courses that are in addition to those core courses required of all master's degree candidates. In conjunction with the written master's examination, the non-thesis student shall successfully complete a final oral examination that will not exceed one and one-half hours in length.

DOCTOR OF PHILOSOPHY
Admission requirements: undergraduate major in physics. Master's degree is not required.
Program requirements: PHY 510, 511, 520, 530, 531, 570, 571, 580, 620, 650, 660 and either 651 or 661. Language requirement is determined by the candidate's committee.

PLANT AND SOIL SCIENCE

M.S.

GRADUATE FACULTY
Professor Eliot C. Roberts, Ph.D., *chairman*. Professors Robert S. Bell, Ph.D., Vladimir G. Shutak, Ph.D., C. Richard Skogley, Ph.D., Irene H. Stuckey, Ph.D., Robert C. Wakefield, Ph.D.; Associate Professors James H. Brown, Jr., Ph.D., Walter P. Gould, Ph.D., Albert E. Griffiths, Ph.D., Robinson J. Hindle, Ph.D., Richard J. Hull, Ph.D.; Assistant Professors D. Thomas Duff, Ph.D., John A. Jagschitz, M.S., John J. McGuire, Ph.D.

Work beyond the M.S. degree in Plant and Soil Science may be developed in cooperation with other departments offering the Ph.D. degree in biological sciences.

SPECIALIZATIONS
Emphasis on one or more of the following plant commodities: turfgrasses, woody ornamentals, flowers, fruits, vegetables, and field crops. Specific programs may feature one or more of the following: soil-plant-climate relationships, physiology, post harvest physiology, propagation, ecology, weed science and plant breeding. Work with radio isotopes, growth regulators and mineral nutrients is considered basic. Plant associations such as exist in the home landscape, along roadsides, and in salt marshlands are suitable for ecological study.

MASTER OF SCIENCE
Admission requirements: GRE and an undergraduate major in agronomy, horticulture, botany, soil science—plant science, or any of the natural sciences.
Program requirements: thesis and background study in plant and soil science, botany, chemistry and statistics.

PLANT PATHOLOGY-ENTOMOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY
Assistant Professor Gordon Field, Ph.D., *acting chairman*. Professors Carl H. Beckman, Ph.D., Theodore W. Kerr, Ph.D.; Emeritus Professor Frank L. Howard, Ph.D.; Associate Professors Noel Jackson, Ph.D., Walter C. Mueller, Ph.D., George J. Stessel, Ph.D.; Adjunct Professors Arthur W. Kaplan, Ph.D., Clarence M. Tarzwell, Ph.D.

SPECIALIZATIONS
Plant pathology, plant nematology, plant virology economic entomology, water quality, biodegradation.

MASTER OF SCIENCE
Admission requirements: GRE with undergraduate major in biological, agricultural or physical sciences.
Program requirements: thesis and seminars.

DOCTOR OF PHILOSOPHY
(Biological Sciences)
Admission requirements: GRE recommended and bachelor's or master's degree in biological, agricultural or physical sciences.
Program requirements: dissertation and participation in seminars.

POLITICAL SCIENCE

M.A., M.P.A.

GRADUATE FACULTY
Professor David D. Warren, Ph.D., *chairman*. Professors John O. Stitely, A.M., Norman L.

Zucker, Ph.D.; Associate Professors Edgar G. Leduc, Ph.D., Arthur B. Stein, Ph.D., Stephen B. Wood, Ph.D.; Assistant Professors Alfred G. Killilea, Ph.D., Gerry B. Sack, M.A., Stephen I. Grossbard, Ph.D.

SPECIALIZATIONS

American government, international relations, politics of the developing areas, urban affairs, comparative governments, public administration.

MASTER OF ARTS AND MASTER OF PUBLIC ADMINISTRATION

Admission requirements: GRE or MAT with undergraduate credit in basic political science and political theory.

Program requirements: thesis and non-thesis option; PSC 553. Non-thesis option for M.A. degree requires oral examination in addition to comprehensives. Internship program required for M.P.A.

An interdisciplinary program involving 18 additional credits in geography, history, and political science leads to a Graduate Certificate in North Atlantic Regional Studies awarded by the Dean of the Graduate School as an adjunct to the M.A. in political science. See International Studies.

PSYCHOLOGY

M.S., Ph.D.

GRADUATE FACULTY

Professor Stanley I. Berger, Ph.D., *chairman.*

Full-time: Professors Albert J. Lott, Ph.D., Peter F. Merenda, Ph.D.; Associate Professors Henry B. Biller, Ph.D., David S. Camp, Ph.D., Lawrence E. Grebstein, Ph.D., Albert Silverstein, Ph.D., William T. Vosburgh, Ph.D., Alan Willoughby, Ph.D.; Assistant Professors Allen Berman, Ph.D., Leila S. Cain, Ph.D., Ira Gross, Ph.D., Cynthia Makokian, Ph.D., James O. Prochaska, Ph.D., Nelson F. Smith, Ph.D.

Part-time: Professor E. J. Archer, Ph.D.; Associate Professor Bernice Lott, Ph.D.; Clinical Professors J. Mohrnheim, M.D., H. Musiker, Ph.D., W. Redmon, M.D.; Clinical Associate Professors H. Farnum, Ph.D., Gerald Groden, Ph.D., M. Silverman, Ph.D., L. Weiner, Ed.D.; Clinical Assistant Professor Roger Richardson, Ph.D.; Adjunct Clinical Professors I. Ersavim, M.D., Y. Karkalas, M.D., M. Nicotra, M.D.

SPECIALIZATIONS

Clinical, general-experimental and school psychology; verbal learning, psychotherapeutic models and outcome, clinical psychodiagnosis, measurement, group dynamics, physiological—sensation, community practices, personality and rehabilitation, alcoholism, exceptional child, aversive conditioning, behavioral modification techniques, learning disabilities, social learning, psycho-neuropsychological concepts of behavioral disorders. Specialization in psychopharmacology is interdepartmental with the Department of Pharmacology.

MASTER OF SCIENCE (School Psychology only)

Admission requirements: MAT and GRE with advanced test; undergraduate major in psychology recommended. Applicants are admitted for September only. Applications must be completed by February 15.

Program requirements: non-thesis (45 to 54 credits); one semester internship.

DOCTOR OF PHILOSOPHY (Clinical, General-Experimental, and School Psychology)

Admission requirements: MAT and GRE with advanced test; evidence of research competency. Applicants are admitted for September only. Applications must be completed by February 15. Prospective applicants are asked to address initial inquiries to the program coordinator for the desired specialization c/o Department of Psychology, but formal application materials must be obtained from and returned directly to the Graduate School Office.

Program requirements: academic core of 18 credits including developmental, social, personality, learning, cognitive perceptual processes, and physiology; research tools, design, and methodology (6 credits); intermediate quantitative methods and methods of psychological research and experimental design; minimum of 18 research credits; two semesters individual and practical teaching in psychology. Additional requirements are imposed to meet the demands of each specific program area.

RESOURCE ECONOMICS

M.S.

For interdepartmental Ph.D. degree program, see Economics, Marine Resource Option.

GRADUATE FACULTY

Associate Professor Albert L. Owens, M.S., *chairman.* Professors Andreas A. Holmsen, Ph.D., Harlan C. Lampe, B.S., Virgil J. Norton, Ph.D., Niels

Rorholm, Ph.D., Irving A. Spaulding, Ph.D.; Associate Professors James D. Bromley, M.S., William H. Wallace, M.S.; Assistant Professors John M. Gates, Ph.D., Bruce W. Mattox, Ph.D., Dennis F. Paulaha, Ph.D., Edmond E. Seay, Jr., Ph.D.; Instructor Paul Mlotok, M.S.

SPECIALIZATIONS

Econometrics, mathematical economics and resource economics, marine economics, market and price analysis, production economics.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and bachelor's degree with strong background in the social sciences, statistics, or mathematics.
Program requirements: 24 credit hours plus thesis.

SOCIOLOGY

M.A.

GRADUATE FACULTY

Professor William R. Rosengren, D.S.Sc., *chairman.* Professors Ralph W. England, Jr., Ph.D., Irving S. Spaulding, Ph.D.; Associate Professor Robert V. Gardner, Ph.D.; Assistant Professors Leon F. Bouvier, Ph.D., Carl Gersuny, Ph.D., Tony McNevin, Ph.D., John J. Poggie, Jr., Ph.D., Lars H. Rydell, Ph.D.; Instructors Michael Bassis, M.A., Roger Sennott, M.A., Richard V. Travisano, M.A.

SPECIALIZATIONS

Population and demography, race relations, medical sociology, criminology, resource development, culture and personality, complex organizations, gerontology.

MASTER OF ARTS

Admission requirements: MAT (preferred) or GRE including advanced sociology; strong background in social sciences. B.A. degree in sociology preferred.
Program requirements: for thesis program, 24 credits including SOC 571, seminar in research methods, and two courses selected from SOC 502, 508, 510 and 512; thesis; familiarity with literature in the M.A. reading list of the department in theory and methodology; oral examination on thesis and reading list. For non-thesis program, 30 credits including SOC 571, 502, 508, 510 and 512; familiarity with literature in the M.A. reading list of the department in theory, methodology and two of four substantive areas; written and oral comprehensive examinations.

SPANISH

M.A.

GRADUATE FACULTY

Associate Professor Ruth H. Kossoff, Ph.D., *chairman,* Department of Languages. Associate Professor Lewis J. Hutton, Ph.D.; Assistant Professor Michael Navascués, Ph.D.; Instructor Maurice H. Bourquin, B.A.

SPECIALIZATIONS

Spanish literature or the literature of the Spanish-speaking world.

MASTER OF ARTS

Admission requirements: MAT or GRE; undergraduate major in Spanish or equivalent, including 12 credits in Spanish or Hispanic-American literature. Qualified students may be admitted with less than 12 credits but must make them up without graduate credit.
Program requirements: all work carried out in Spanish. For thesis option, SPA 591, seven courses (21 credits), and thesis (6 credits). For non-thesis option, SPA 591, and nine courses (27 credits).

SPEECH PATHOLOGY AND AUDIOLOGY

M.A., M.S.

GRADUATE FACULTY

Professor Walter J. Beaupre, Ph.D., *director of graduate programs.* Professor Agnes G. Doody, Ph.D.; Associate Professor Ruth FitzSimons, D.Ed.; Assistant Professor Richard E. Bailey, Ph.D.; Clinical Assistant Professors Barry J. Regan, D.Ed., Ray R. Seitz, M.S.

SPECIALIZATIONS

Audiology, speech pathology and speech science.

MASTER OF ARTS AND
MASTER OF SCIENCE

Admission requirements: MAT or GRE (in special cases); 24 undergraduate credit hours in general speech, speech development, child development, psychology, or education; normal speech and hearing.
Program requirements: for M.A. in speech pathology (36 credit hours), thesis, SPE 504, 24 credit hours in speech pathology, 6 credit hours in audiology. *For M.A. in audiology* (36 credit hours), thesis, SPE 504, 24 credit hours in audiology, 6 credit hours in speech pathology. *For M.S. in*

speech pathology (39 credit hours), non-thesis, SPE 504, 30 credit hours in speech pathology, 6 credit hours in audiology. *For M.S. in audiology* (39 credit hours), non-thesis, SPE 504, 30 credit hours in audiology, 6 credit hours in speech pathology.

TEXTILES, CLOTHING AND RELATED ART

M.S.

GRADUATE FACULTY

Professor Virginia V. Carpenter, Ph.D., *chairman.* Associate Professor Marion L. Fry, M.S.; Assistant Professors Patricia Helms, Ph.D., Mary M. James, M.S., Patricia J. Weeden, M.S.

SPECIALIZATIONS

Social science aspect of textiles and clothing, physical science aspect of textiles and clothing, historic textiles and costume.

MASTER OF SCIENCE

Admission requirements: GRE or MAT and undergraduate degree in textiles and clothing, social science or allied fields.

Program requirements: thesis or non-thesis option, 30 credits. For thesis option, TXC 424, 580; courses in statistics recommended. For non-thesis option, TXC 424, 550, 560, 570.

ZOOLOGY

M.S., Ph.D. (Biological Sciences)

GRADUATE FACULTY

Professor Robert K. Chipman, Ph.D., *chairman.* Professors John W. Crenshaw, Jr., Ph.D., Robert A. DeWolf, D.Sc., Carl S. Hammen, Ph.D., Robert W. Harrison, Ph.D., Kerwin E. Hyland, Jr., Ph.D., Saul B. Saila, Ph. D., Howard E. Winn, Ph.D., Donald J. Zinn, Ph.D.; Associate Professors Clarence C. Goertemiller, Jr., Ph.D., Robert B. Hill, Ph.D., John A. Mathewson, M.S., C. Robert Shoop, Ph.D.; Assistant Professors J. Stanley Cobb, Ph.D., Frank H. Heppner, Ph.D., William H. Krueger, Ph.D.; Adjunct Professors David E. Bass, Ph.D., Melbourne E. Carriker, Ph.D., Herndon G. Dowling, Ph.D., Robert H. Gibbs, Ph.D., Victor H. Hutchison, Ph.D., Gilles LaRoche, Ph.D., Thomas H. Roderick, Ph.D., Karl E. Schaefer, M.D.

SPECIALIZATIONS

Acarology, animal behavior, cytology, ecology, embryology, endocrinology, entomology, fisheries biology, genetics, herpetology, histology, ichthyology, invertebrate zoology, limnology, mammalogy, ornithology, parasitology, physiological ecology, physiology, radioecology, reproductive biology, taxonomy.

MASTER OF SCIENCE

Admission requirements: GRE with advanced test and bachelor's degree with major in zoology, biology or allied field.

Program requirements: thesis; proficiency in one foreign language; ZOO 595, 596.

DOCTOR OF PHILOSOPHY (Biological Sciences)

Admission requirements: master's degree is not required. GRE with advanced test and bachelor's degree with major in zoology, biology or allied field.

Program requirements: dissertation, two languages (one of which may be substituted, with faculty approval), ZOO 595, 596.

SPECIAL FINANCIAL AID

Traineeships awarded through the Institute of Environmental Biology.

339
DIGITAL EQUIPMENT CORPORATION MAYNARD MASSACHUSETTS

Fall 72 done start w/spring 73. Stat w/500

F = Fall 71 (according to 1/3/72 course enrollments)

S = Spring 72 (according to 4/19/72 course enrollments)

Courses of Instruction

All graduate-level courses are described in full on the following pages. Undergraduate courses numbered at the 400-level, permitted for graduate credit in some cases, are described in the *University Catalog* and are listed here for reference only. Courses at the 500-level comprise the majority of course work between the bachelor's and the master's degrees. Those at the 600-level are advanced graduate courses. The 900-level courses are special types of graduate courses including graduate courses for which no degree credit is given. They include courses offered to remedy deficiencies as well as workshops, institutes, and courses offered one time only by visiting faculty.

Courses with two numbers, e.g. **APA 501, 502,** indicate a year's sequence and the first course is either a prerequisite for the second or at least the two cannot be taken in reverse order without special permission. Parentheses after a course number enclose either the old course number, or, in cases of multiple listings, the departments and numbers under which the course is also offered.

The Roman numeral indicates the semester the course will be offered; the Arabic numeral indicates the credit hours. Distribution of class hours each week is in parentheses. *S/U credit* signifies a course in which only satisfactory or unsatisfactory grades are given. The instructor's name follows the course description.

ACCOUNTING (ACC)

422 Advanced Cost Accounting *II, 3*

431 Advanced Accounting *II, 3*

443 Federal Tax Accounting *I, 3*

461 Auditing *II, 3*

512 Controllership *I, 3*
Study of controller's functions, techniques and responsibilities for planning with text, problem and case assignments. *(Lec. 3)* Staff

F F **513 (413) Accounting Systems** *I, 3*
Principles and problems related to design and installation of accounting control systems with emphasis on automated data processing. *(Lec. 3) Prerequisite: ACC 312 and permission of department.* Staff

S **535 (435) Advanced Problems in Accounting** *II, 3*
General and specialized accounting problems that constitute the subject matter of CPA examinations. *(Lec. 3) Prerequisite: ACC 431.* Staff

S **544 (444) Topics in Federal Taxation** *II, 3*
Special topics in areas of partnerships, corporations, trusts, and estates. *(Lec. 3) Prerequisite: ACC 443 and permission of department.* Staff

~~599~~

F F **611 Managerial Accounting** *I and II, 3*
Stewardship responsibilities of management; the functions of accounting in relation to planning and control; income tax planning and quantitative techniques. *(Lec. 3) Prerequisite: ACC 910.* Staff

F F **618 Current Accounting Theory** *I, 3*
A critical examination of accounting theory and practice designed to develop research techniques with emphasis on financial accounting. *(Lec. 3) Prerequisite: ACC 312 or 611.* Staff

S **619 Current Accounting Theory** *II, 3*
A critical examination of accounting theory and practice designed to develop research techniques with emphasis on managerial accounting. *(Lec. 3) Prerequisite: ACC 321 or 611.* Staff

910 Financial Accounting *I and II, 3*
Concepts of financial accounting in the analysis and interpretation of financial statements; emphasis on accounting principles. *(Lec. 3) Graduate credit for matriculated MBA students only.* Staff

ANIMAL PATHOLOGY (APA)

422 Poultry Diseases *II, 3*

461 Laboratory Animal Technology *I, 3*

501, 502 Seminar *I and II, 1 each*
Preparation and presentation of scientific papers on selected subjects in animal pathology and virology. Staff

534 Animal Virology *II, 3*
Basic properties, classification and evolution of animal viruses. Individual agents are studied in detail. *(Lec. 3) Prerequisite: BAC 432, 533 and permission of department.* Yates and Chang

536 Virology Laboratory *II, 2*
Methods employed in diagnosis and for the investigation of the biological, physical, and chemical properties of animal viruses. *(Lab. 6) Prerequisite: APA 534. (May be taken simultaneously.)* Yates and Chang

538 Epidemiology of Viral and Rickettsial Diseases *II, 2*
Principles of epidemiology. Interrelationships of host, environment and agent in viral and rickettsial diseases. *(Lec. 2) Prerequisite: APA 534. (May be taken simultaneously.) In alternate years, next offered 1971-72.* Chang

591, 592 Special Projects *I and II, 1-3 each*
Research projects in animal pathology and virology. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ANIMAL SCIENCE (ASC)

401, 402 Animal Science Seminar *I and II, 1 each*

412 Animal Nutrition *II, 3*

414 Advanced Ration Formulation *II, 3*

415 Physiology of Lactation *I, 3*

432 Biology of the Fowl *II, 3*

441 Food Analysis *I, 3*

442 Animal Breeding *II, 3*

444 Food Quality *II, 3*

461 (or APA 461) Laboratory Animal Technology *I, 3*

470 Population Genetics *II, 3*

472 Physiology of Reproduction *II, 3*

491, 492 Special Projects *I and II, 1-3 each*

512 Advanced Animal Nutrition *II, 3*
Comparative digestion and metabolism of protein, carbohydrate, and fat by ruminant and nonruminant animals. The role of vitamins and minerals in metabolism. Experimental methods in animal nutrition will be discussed. Emphasis on the ruminant animal. *(Lec. 2, Lab. 2) Prerequisite: ASC 412, CHM 124 or BCH 581 and permission of department. In alternate years, next offered 1971-72.* Hinkson

532 Experimental Design
See Experimental Statistics 532.

591, 592 Research Problems *I and II, 3 each*
Research problems to meet individual needs of graduate and honors students in the fields of animal breeding, nutrition, or physiology and food science. *(Lab. 6, TBA) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for Biochemistry of Foods, see FRC 431, 432.

ANTHROPOLOGY (APG)

401 History of Anthropological Theory *II, 3*

407 Economic Anthropology *I and II, 3*

506 Psychological Anthropology *II, 3*
Examination of behavior in different cultures employing psychological concepts and theories. *(Lec. 3) Prerequisite: PSY 234 and 435 or SOC 204 and permission of department.* Poggie

ART (ART)

403 Studio—Seminar I *I and II, 3-6*

404 Studio—Seminar II *I and II, 3-6*

405 Studio—Seminar III *I and II, 3-6*

406 Studio—Seminar IV *I and II, 3-6*

462 Modern Art Seminar: Art since 1945 *II, 3*

469, 470 Art History—Senior Projects

501 Graduate Studio—Seminar I *I and II, 3-12*
Intensive independent studio work under the guidance of appropriate advisers. Periodic critiques and discussions related to work of all participants in the course. *(Studio 6-24) Prerequisite: permission of department.* Staff

502 Graduate Studio—Seminar II *I and II, 3-12*
Continuation of ART 501. *(Studio 6-24) Prerequisite: permission of department.* Staff

ASTRONOMY (AST)

408 Introduction to Astrophysics *II, 3*

BACTERIOLOGY (BAC)

412 Food Microbiology *II, 3*

432 Pathogenic Bacteriology *II, 3*

491, 492 Research in Bacteriology *I and II, 1-6 each*

495, 496 Seminar in Bacteriology *I and II, 1 each*

533 Immunity and Serology *I, 3*
Various immune reactions, nature of antigens and antibodies, and formation and action of latter. *(Lec. 2, Lab. 3) Prerequisite: BAC 201 and 1 semester organic chemistry and senior standing.* Carpenter

541 Physiology of Bacteria *I, 3*
Chemical and physical nature of bacteria, phenomena of bacterial growth and multiplication, environmental factors which affect bacteria. *(Lec. 2, Lab. 3) Prerequisite: BAC 201, 2 semesters organic chemistry, and 1 semester biochemistry.* Wood

544 Bacterial Metabolism *II, 2*
Energy-yielding reactions, metabolic pathways in the dissimilation of carbon and nitrogen compounds and the biosynthesis of cellular components. *(Lec. 2) Prerequisite: BCH 311 or equivalent.* Wood

546 Bacterial Metabolism Laboratory *II, 2*
Application of methods used in the study of bacterial metabolism. *(Lab. 6) Prerequisite: permission of department.* Wood

552 Microbial Genetics *II, 3*
Recent research on the mechanisms of mutation and genetic recombination, the process of DNA replication, the genetic code, and regulation of DNA, RNA, and protein synthesis in microorganisms. *(Lec. 2, Lab. 3) Prerequisite: BAC 201, BOT 352, and BCH 311.* Cohen

593, 594 The Literature of Bacteriology *I and II, 3 each*
Thorough study of original literature of some phase of bacteriology. Written abstracts or papers on assigned topics are discussed in weekly conferences with instructor. *(Lec. 3)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621 Systematic Bacteriology *I, 3*
Conferences, assigned readings, and laboratory work designed to give a knowledge of principles of classification of bacteria as well as methods of identifying and describing unknown species. *(Lab. 6) Prerequisite: BAC 432 and either BAC 412 or 533. In alternate years, next offered 1971-72.* Houston

691, 692 Research in Bacteriology *I and II, 3 each*
Assigned research on an advanced level. Student required to outline problem, conduct the necessary literature survey and experimental work, and present his observations and conclusions in a report. *(Lab. 6) Prerequisite: graduate standing.* Staff

695, 696 Graduate Research Seminar *I and II, 1 each*
Reports of research in progress or completed. *(Lec. 1) Required of all graduate students in bacteriology.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: for Virology, see Animal Pathology and Plant Pathology; for Marine Bacteriology, see Oceanography.

BIOCHEMISTRY (BCH)

400 Chemistry and Biochemistry of Carbohydrates *II, 3*

411 Biochemistry Laboratory *II, 3*

531, 532, 533, 534 Seminar in Biochemistry *I and II, 1 each*
Presentation of a seminar on selected topics in contemporary biochemistry. *(Lec. 1) Prerequisite: permission of department.* Staff

541, 542 Laboratory Techniques in Biochemistry *I and II, 3 each*
Study and application of these biochemical techniques: enzyme preparation and purification, cell fractionation, ion-exchange and paper chromatography,

manometry, fluorometry, polarography, radioactive tracer techniques as applied to biochemical research problems. Assigned research on advanced level using above techniques. *(Lab. 9) Prerequisite: permission of department.* Purvis and Dain

581, 582 General Biochemistry *I and II, 3 each*
Systematic treatment of the principles of biochemistry. A basic course dealing with the chemistry of biological substances and the transformations in living organisms. *(Lec. 3) Prerequisite: CHM 221, 222.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601 Enzymes *I, 3*
Factors affecting the rate of catalysis in enzymic reactions. The thermodynamic and kinetic characteristic of enzymes profiles. *(Lec. 1½, Lab. 8) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1971-72.* Purvis and Tremblay

602 The Mitochondrion *II, 3*
Detailed study of the structure, properties and function of the mitochondrion. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1971-72.* Purvis

611 Intermediary Metabolism *I, 3*
Intensive study of the metabolic pathways of carbohydrates, lipids and nitrogenous compounds and their interrelationships. The effects of hormonal and nutritional status on the activity of these pathways. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1972-73.* Purvis and Tremblay

612 Biochemical Regulation of Cellular Metabolism *II, 3*
Biochemical regulatory mechanisms of cellular metabolism in micro-organisms and mammalian systems, at the level of the genome, protein synthesis and enzyme catalysis. *(Lec. 3) Prerequisite: BCH 581, 582, and/or permission of department. In alternate years, next offered 1972-73.* Tremblay

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BIOPHYSICS (BPH)

521 Introductory Biophysics *I, 3*
The use of viscosity, diffusion, ultracentrifugation, light scattering, spectrophotometry and X-ray diffraction to study the size, shape, structure, and molecular weight of biological macromolecules. *(Lec. 3) Prerequisite: CHM 332 and MTH 243.* Hartman

522 Intermediate Biophysics *II, 3*
Molecular structure, physical chemistry and genetics of viruses and nucleic acids. *(Lec. 3) Prerequisite: BPH 521. In alternate years, next offered 1971-72.* Hartman

523, 524 Special Topics in Biophysics *I and II, 1-6 each*
Advanced work arranged to suit the individual needs of the student. Lecture and/or laboratory according to the nature of the problem. Credits not to exceed a total of 12. *Prerequisite: permission of department.* Staff

526 Nuclear and Radiation Physics in Biology *II, 4*
Fundamental aspects of radioactivity; alpha and beta particles and gamma rays, radiation detection; application of tracer techniques to biological systems; interaction of high energy radiations with matter and with biological systems; health physics and disposal of radioactive wastes. *(Lec. 2, Lab. 6) Prerequisite: CHM 332 or PHY 340 and BIO 102 or permission of department. In alternate years, next offered 1972-73.* Fisher

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611 Advanced Biophysics *I, 3*
Physical and chemical properties of macromolecules in solution. *(Lec. 3) Prerequisite: BPH 521 or permission of department. In alternate years, next offered 1972-73.* Fisher

621 Electron Microscopy *I, 4*
Introduction to electron microscopy, electron optics, maintenance and operation; techniques of specimen preparation for particulate materials, spraydrop, suspensions, freeze drying, critical point drying, shadow casting, negative staining, fixation, and ultramicrotomy. *(Lec. 2, Lab. 6) Prerequisite: permission of department.* Fisher and Staff

651, 652 Research in Biophysics *I and II, 3 each*
Student is required to outline a research problem, conduct necessary literature survey and experimental work and present his observations and conclusions in a report. *(Lab. 6) Prerequisite: graduate standing.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BOTANY (BOT)

402 Systematic Botany *I, 3*

411 Plant Anatomy *I, 3*

416 Phycology *II, 3*

417 Aquatic Plant Ecology *I, 3*

424 Plant Ecology *II, 3*

432 Mycology: Introduction to the Fungi *I, 4*

442 Plant Physiology *I and II, 3*

453 Cytology *I, 3*

512 Plant Morphology *II, 3*
Comparative survey of development, form and anatomy of extinct and extant vascular plants and a modern interpretation of evidence concerning their interrelationships. *(Lec. 2, Lab. 2) Prerequisite: BOT 411 or equivalent. In alternate years, next offered 1972-73.* Hauke

524 Methods in Plant Ecology *I, 3*
Methods used in the analysis of vegetation and micro environments. Emphasis on quantitative techniques in analysis of vegetation, soil and microclimate, and techniques in physiological ecology. *(Lec. 2, Lab. 2) Prerequisite: BOT 111 and 424 or equivalent; EST 411, 412 desirable. In alternate years, next offered 1972-73.* Halvorson

526 (or GEG 526) Plant Geography *I, 3*
Environmental and non-environmental factors controlling distribution of species and vegetative types; the origin, development and senescence of floras; distribution of modern vegetation-types and theories of modern day species distribution. Several lectures will be presented by a member of the Department of Geography. *(Lec. 2, Lab. 2) Prerequisite: BOT 402, 424, or permission of department. In alternate years, next offered 1971-72.* Halvorson

534 Physiology of the Fungi *I, 3*
Life processes of fungi with particular emphasis on chemical composition, organic and mineral nutrition, toxic and stimulating agencies, and metabolism. Also stresses phenomena of variation of growth and sporulation as affected by various environmental factors. *(Lec. 2, Lab. 2) Prerequisite: BOT 332, or permission of department. In alternate years, next offered 1971-72.* Caroselli

536 Phytopathological Techniques *I, 3*
Research procedures in plant pathology including isolation and inoculation practices, maintenance of pathogenes, disease diagnosis, use of techniques for determining fungi-toxic and phytotoxic properties of chemicals, use of literature and method of preparing manuscripts. *(Lec. 1, Lab. 4) Prerequisite: BOT 332 or permission of department. In alternate years, next offered 1972-73.* Caroselli

540 Experimental Mycology *I, 4*
Growth and reproduction of fungi as affected by nutritional, environmental and genetic factors, with emphasis on experimental methods. *(Lec. 2, Lab. 4) Prerequisite: BOT 432 and BAC 201, or permission of instructor. In alternate years, next offered 1971-72.* Goos

542 Medical Mycology *II, 3*
Study of fungi pathogenic for man and animals. *(Lec. 2, Lab. 2) Prerequisite: BOT 432 or BAC 201, or permission of instructor.* Goos

545 Environmental Plant Physiology *I, 3*
Responses of plants to environmental factors are considered on the cellular and organismal level in relation to changes which occur in the physiology and metabolism of plants. *(Lec. 2, Lab. 3) Prerequisite: BOT 442 or equivalent, organic chemistry. In alternate years, next offered 1971-72.* Albert

554 Cytogenetics *I, 4*
Comparisons of various types of crossing-over, chromosomal aberrations and their effects, mutation and other cytogenetic phenomena in fungi and higher organisms. Laboratory studies of meiosis in maize, identification of chromosomes and induced rearrangements. *(Lec. 2, Lab. 4) Prerequisite: BOT 352, 453, or permission of instructor.* Mottinger

562 Seminar in Plant Ecology *II, 2*
Discussion of recent topics and investigations pertinent to plant ecology. Involves library research, oral presentation of reports, and group discussions. *(Lec. 2) Prerequisite: BOT 424 or equivalent, and permission of instructor. In alternate years, next offered 1971-72.* Halvorson

579 Advanced Genetics Seminar
See Zoology 579.

581, 582 Botany Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to botany. *(Lec. 1) Prerequisite: required of graduate students majoring in botany.* Staff

591, 592 Botanical Problems *I and II, 3 each*
Special botanical work arranged to meet needs of individual students who desire advanced work in botany and who are prepared to undertake special problems. *(Lec. 1, Lab. 4) Prerequisite: permission of department.* Staff

593, 594 Botanical Problems *I and II, 3 each*
Similar to BOT 591, 592 but arranged to meet needs of individual students who desire to take further advanced work in botany. *(Lec. 1, Lab. 4) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

631 to 635 Advanced Mycology Seminars *I and II, 2 each*
Specialized and advanced treatment and research in the major groups of fungi: cellular and acellular slime molds; phycomycetes; ascomycetes; basidiomycetes; deuteromycetes. *(Lec. 2) Prerequisite: permission of instructor. BOT 631 Cellular and Acellular Slime Molds, offered in 1971-72.* Goos

661 Phytoplankton Taxonomy
See Oceanography 661.

663 Phytoplankton Physiology
See Oceanography 663.

664 Phytoplankton Ecology
See Oceanography 664.

667, 668, 669 Advanced Phytoplankton Seminars
See Oceanography 667, 668, 669.

691, 692 Botanical Problems *I and II, 1-6 each*
Special work to meet needs of individual students who are prepared to undertake special problems. *(Lec. 3 or Lab. 6) Prerequisite: permission of department.* Staff

693, 694 Research in Botany *I and II, 3 each*
Assigned research, subject matter of which is to be arranged with a member of department and with the approval of the head of the department. *(Lab. 6)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

BUSINESS EDUCATION (BED)

421 Directed Study *I and II, 3*

422 Special Problems *I and II, 3*

427 Organization, Administration and Methods of Teaching Distributive Education *I, 3*

428 Coordinating and Developing Curriculum for Cooperative Vocational Business and Distributive Education *I, 3*

520 Research and Methods in Teaching Office Occupations Subjects *I, 3*
Psychological principles of skill building, content, methods of teaching, curriculum materials, current thought, and evaluation in the teaching of office occupations subjects. *(Lec. 3)* Staff

522 Improvement of Instruction in Social Business Subjects *II, 3*
Research, objectives, methods of instruction, curriculum materials, current thought, and evaluation in the teaching of such subjects as economics, consumer economics, economic geography, business law, and general business. *(Lec. 3)* Staff

524 Foundations and Recent Developments in Business Education *II, 3*
Philosophy and objectives of business education, principles of curriculum development and evaluation, supervisory problems, organization and administration of cooperative part-time programs, historical developments, legislation, recent developments, and current status of business education. *(Lec. 3)* Staff

525 Research Seminar in Business Education *I, 3*
Analysis of research studies in the field. Research technique applied to business education. Emphasis on the reading, interpretation, and application of research findings to business education. Planning research projects. The planning and approval of an outline for a field study project is a requirement of this course. *(Lec. 3) Prerequisite: a basic course in statistics and permission of department.* Staff

526 Field Study and Seminar in Business Education *I and II, 3*
Carrying out of the field study project approved in BED 525 with attendance and participation in seminar meetings. *(Lec. 3) Prerequisite: a basic course in statistics and BED 525.* Staff

BUSINESS LAW (BSL)

900 Law of Business *I and II, 3*
Outline of American legal system; substantive rules of law in contemporary business environment; legal aspects of business transactions. *(Lec. 3) Graduate credit for matriculated MBA students only.* Geffner

BUSINESS STATISTICS (BST)

501, 502 Advanced Business Statistics *I and II, 3 each*
BST 501: Application to scientific research of statistical techniques of simple and multiple regression and correlation, orthogonal polynomials, analysis of variance and experimental design. Packaged computer programs extensively used. *BST 502:* Continuation of BST 501. *(Lec. 3) Prerequisite: permission of instructor.* Armstrong, Jarrett and Shen

981 Fundamental Business Statistics *I and II, 3*
Statistical methods as tools of management; the collection and interpretation of data; statistical inference and decision-making; regression and correlation. *(Lec. 3) Graduate credit for matriculated MBA students only.* Gross, Shen and Shih

CHEMICAL ENGINEERING (CHE)

425 Process Dynamics and Control *II, 3*

437 Materials Engineering *I and II, 3*

464 Industrial Reaction Kinetics *I, 2*

501, 502 Graduate Seminar *I and II, 1 each*
Seminar discussions including the presentation of papers based on research or detailed literature surveys. *(Lec. 1) Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

530 Polymer Chemistry *I, 3*
Polymer structure, molecular forces, glass and crystalline transitions, solution properties, polymerization kinetics, molecular weight distribution, fractionation, viscoelastic properties and transport processes. *(Lec. 3) Prerequisite: CHM 222 and 332 or permission of instructor.* Barnett

531 Polymer Engineering *II, 3*
Polymer processing and mechanical properties of polymers. *(Lec. 3) Prerequisite: CHE 342 or 344 and 530, or permission of instructor.* Barnett

533 Engineering Metallurgy *II, 3*
Application of metallurgy in engineering. Design and production of sound castings and ingots, the metallurgy of welding and brazing, the shaping of metals and alloys by plastic deformation and the development of special properties. *(Lec. 2, Lab. 3) Prerequisite: CHE 332.* Mairs

534 (or OCE 534) Corrosion and Corrosion Control *I, 3*
Chemical nature of metals, electrochemical nature of corrosion. Types of corrosion, influence of environment, methods of corrosion control, behavior of engineering materials, all with special emphasis on the ocean environment. *(Lec. 3) Prerequisite: permission of instructor.* Soltz

535 (or OCE 535) Advanced Course in Corrosion *II, 3*
The various types of corrosion problems occurring in modern industry. In-depth comparison of the various methods available to avoid, reduce, or eliminate corrosion. Continuation of CHE 534 *(Lec. 3) Prerequisite: CHE 534 or permission of instructor.* Soltz

537 Advanced Materials Engineering *II, 3*
Engineering properties, molecular design and applications of materials. Synthesis, fabrication and processing of materials. Effects of environment on materials, materials products devices and systems. *(Lec. 3) Prerequisite: CHE 437 and PHY 340 or 341.* Gielisse

538 Nuclear Metallurgy
See Nuclear Engineering 538.

571 Analysis of Engineering Data *II, 3*
Application of some of the modern mathematical techniques to the analysis of engineering data. *(Lec. 3) In alternate years, next offered 1971-72.* Votta

572 X-ray Diffraction and Fluorescence *I, 3*
Fundamentals, properties, and applications of X-rays for identification and chemical analysis of materials, determination of lattice parameters, phase transformations, textures, residual stresses, grain and particle sizes, film and plate thicknesses. *(Lec. 2, Lab. 3) Prerequisite: PHY 340 or 341.* Mohrnheim

574 Biochemical Engineering *I, 3*
Introduction to biotechnology. Includes properties of biological materials, dynamics, control and operation of biological systems and processing of biological materials. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1972-73.* Thompson

581 Introduction to Nuclear Engineering
See Nuclear Engineering 581.

582 Radiological Health Physics
See Nuclear Engineering 582.

583 Nuclear Reactor Theory
See Nuclear Engineering 583.

585 Measurements in Nuclear Engineering
See Nuclear Engineering 585.

586 Nuclear Reactor Laboratory
See Nuclear Engineering 586.

591, 592 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12). Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

613 Advanced Chemical Engineering Thermodynamics *I, 2*
Applications of the first, second and third laws of thermodynamics and their relation to chemical engineering processes. Emphasis on properties of fluids, chemical and physical equilibria and refrigeration. *(Lec. 2) In alternate years, next offered 1972-73.* Votta

614 Advanced Chemical Engineering Thermodynamics *II, 2*
Continuation of CHE 613. *(Lec. 2) Prerequisite: CHE 613. In alternate years, next offered 1972-73.* Votta

625 Automatic Process Control *II, 3*
Theory of automatic control is applied to industrial processing systems. *(Lec. 3) In alternate years, next offered 1971-72.* Shilling

637 (or IDE 641) Molecular Aspects of Materials Processing *I or II, 3*
Detailed analysis of the fundamental physical and chemical aspects of generation, fabrication and application of materials in processing. Includes major material groups, the molecular nature of material interaction, and the mechanical, chemical, and thermal theories of specific processing modes. *(Lec. 3) Prerequisite: CHE 437 or permission of instructor.* Gielisse

640 Transport Phenomena I *I, 3*
Analysis of transport processes in fluids with emphasis on diffusion of matter. *(Lec. 3) Prerequisite: MTH 244 and CHE 343 or permission of instructor.* Barnett

641 Transport Phenomena II *II, 3*
Interphase transfer, turbulent transport processes and boundary layer theory, with application to fixed and fluid bed processes, biochemical, biomedical and electrochemical systems. *(Lec. 3) Prerequisite: CHE 640.* Barnett

643 Fluid Dynamics *II, 3*
Advanced problem course dealing with isothermal and nonisothermal flow of compressible and incompressible fluids. *(Lec. 3) In alternate years, next offered 1972-73.* Madsen

644 Process Heat Transfer *II, 3*
Advanced study of heat transfer by conduction in the steady and unsteady state, radiation and convection. *(Lec. 3) In alternate years, next offered 1971-72.* Madsen

645 (or MCE 645) Boiling Heat Transfer and Two-phase Flow *I, 3*
Nucleation and bubble growth, pool boiling, and flow boiling. Hydrodynamics of two-phase flow, the boiling crisis, and instabilities in boiling systems. *(Lec. 3) Prerequisite: MCE 546, CHE 644 or permission of instructor. In alternate years, next offered 1971-72.* Madsen and Test

646 Radiation Heat Transfer
See Mechanical Engineering 646.

647 Mass Transfer I *I, 3*
Advanced course dealing with the application of mass transfer theory in the distillation of binary, multicomponent, and complex mixtures. *(Lec. 3) In alternate years, next offered 1971-72.* Thompson

648 Mass Transfer II *II, 3*
Advanced study of mass transfer theory applied to gas-liquid, liquid-liquid and solid-liquid systems. *(Lec. 3) In alternate years, next offered 1971-72.* Barnett

651, 652 Advanced Design *I and II, 3 each*
Advanced course in the coordination of chemical or nuclear engineering principles and economics to the design of complete industrial plants. Students work design problems on an individual basis, with the guidance of one or more instructors. Staff

664 Applied Reaction Kinetics *II, 3*
Application of principles of chemical reaction kinetics to industrial processes. *(Lec. 3) In alternate years, next offered 1972-73.* Shilling

682 Radiation Shielding
See Nuclear Engineering 682.

683 Advanced Nuclear Reactor Theory
See Nuclear Engineering 683.

687 Nuclear Chemical Engineering
See Nuclear Engineering 687.

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem. Credits not to exceed a total of 12.) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CHEMISTRY (CHM)

401 Intermediate Inorganic Chemistry *I, 3*

412 Instrumental Methods of Analysis *II, 3*

414 Instrumental Methods of Analysis Laboratory *II, 2*

421 (422) Advanced Organic Chemistry *I, 3*

425 Qualitative Organic Analysis *I, 4*

434 Applications of Chemical Data Processing *II, 3*

435 Advanced Physical Chemistry *I, 3*

441, 442 Physical Chemistry *I and II, 3 each*

501 Molecular Structure in Inorganic Chemistry *I or II, 3*
Systematic analysis of bonding schemes and structural aspects of molecular systems encountered in inorganic chemistry. Special emphasis on electron density distributions, physical methods of analysis, and practical applications of quantum mechanics. *(Lec. 3) Prerequisite: CHM 401.* Petersen

503 Chemistry of the Representative Elements *I, 3*
Guided literature study. Special emphasis placed on compounds of boron, silicon, phosphorus, sulfur, fluorine and related elements in Groups III-VII. *(Lec. 3) Prerequisite: CHM 401.* Nelson

504 (402) Physical Methods of Inorganic Chemistry *II, 3*
Theory and application of principal physical methods used in the preparation, analysis, and investigation of properties of inorganic chemicals, with emphasis on investigations concerning molecular structure and electron density distributions in molecular systems. *(Lec. 2, Lab. 3) Prerequisite: CHM 332.* Petersen

508 Inorganic Reaction Mechanisms *II, 3*
Kinetics and mechanisms of reactions in aqueous solution treated with regard to techniques, results, and theoretical interpretation. Instrumentation for studying rapid reactions in solution, relaxation methods, electron transfer rates, hydrolytic and solvolytic reactions, metal ion complexation, and reactions of biochemical significance. *(Lec. 3) Prerequisite: CHM 332 or equivalent.* Kirschenbaum

511 Chemical Spectroscopy *I, 3*
Principles and equipment used in modern spectrochemical analysis with emphasis on emission spectroscopy. Discussion and spectroscopy of infrared and ultraviolet regions, absorption and Raman spectroscopy. *(Lec. 3)* Staff

512 Advanced Instrumental Analysis *II, 3*
Continuation of CHM 412 with emphasis on principles and recent developments in application of physico-chemical phenomena to solution of chemical problems. *(Lec. 3) Prerequisite: CHM 412, PHY 340, and MTH 243.* Staff

513 Advanced Analytical Laboratory *I, 3*
Projects designed to acquaint student with newer and more advanced techniques of classical and instrumental analytical methods. Literature searches, conferences and a written report required. Course normally required of all first year graduate students in analytical chemistry. *(Lab. 9) Prerequisite: CHM 212, 222, and 332 and permission of department.* Fasching and Rosie

514 Thermal Methods of Analysis *II, 3*
Theory and applications of the principles of thermodynamics to the solution of analytical problems. Quantitative treatment will be given to techniques such as differential scanning calorimetry, precision calorimetry and miscellaneous thermal methods of analysis. Particular emphasis on the evaluation of thermodynamic data obtained from these techniques and its application to the solution of analytical problems. *(Lec. 3) Prerequisite: CHM 331.* Staff

516 Ion Exchange and Gas Chromatography *II, 3*
Principles of ion exchange separations including equilibria, kinetics, column operation and applications of ion exchangers. Principles of gas chromatography including theory of column efficiency, equipment design, column selection, qualitative and quantitative calibration. *(Lec. 2, Lab. 3) Prerequisite: CHM 332.* Rosie and Fasching

518 Radiochemistry *II, 3*
Theory and principles of nuclear science as applied to the various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, emphasis on solution of chemical and environmental research problems with the techniques of nuclear chemistry. *(Lec. 3) Prerequisite: CHM 332, PHY 214 or permission of instructor.* Fasching

520 Radiochemistry Laboratory *II, 1*
Laboratory studies of the theory and principles of nuclear science as applied to various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, instrumental neutron activation analysis, fission process, and uses of radioactive tracers. *(Lab. 3) Prerequisite: CHM 518 concurrently, CHM 332 and PHY 214, or permission of instructor.* Fasching

522 Advanced Organic Chemistry *II, 3*
Modern synthetic reactions and their applicability to such areas as natural products and heterocyclic chemistry. *(Lec. 3) Prerequisite: CHM 421 or permission of instructor.* Abell

528 Organo-inorganic Chemistry *II, 3*
Interaction of organic and inorganic molecules. Uniqueness of carbon and the effects that inorganic moieties have on bonded organic fragments described. Organometallic chemistry, the transition metal chelate complexes and carbon in combination with the representative elements considered. Model biochemical systems analyzed. *(Lec. 3) Prerequisite: CHM 401 and 422 or equivalent.* Rosen

531 (631) Chemical Kinetics *I, 3*
Topics include transition state theory, unimolecular decompositions, kinetics of fast reactions, reactions in molecular beams, shock waves, theoretical studies of potential energy surfaces and kinetic isotope effects. *(Lec. 3) Prerequisite: CHM 634 or permission of instructor. In alternate years, next offered 1971-72.* Gonzalez and Brown

533 (433) Elementary Chemical Thermodynamics *I, 3*
Laws of chemical thermodynamics and their application to homogeneous and heterogeneous systems. The classical development of this subject is followed. *(Lec. 3) Prerequisite: CHM 332.* Kraus

535 Chemical Applications of Group Theory *I, 2*
Fundamental principles of group theory will be developed insofar as they are used in simplifying problems of a chemical nature. Group theoretical approach to several typical problems such as hybrid orbitals, molecular orbitals, and molecular vibrations. *(Lec. 2) Prerequisite: CHM 332.* Brown

536 Molecular Spectroscopy and Structure *II, 3*
Theory of molecular dynamics and the interaction of electromagnetic radiation with matter. Absorption and emission spectra in the infrared, far-infrared, and

microwave regions will be considered along with Raman scattering in the visible region. Use of spectral results in determining physical properties and elucidating molecular structures will be emphasized. *(Lec. 3) Prerequisite: CHM 535 or permission of instructor.* Brown

537 Quantum Chemistry I *I, 3*
Quantum theory of matter. Topics include: development of the Schrodinger equations, potential barrier problems, the harmonic oscillator and the hydrogen atom. *(Lec. 3) Prerequisite: CHM 442, MTH 244.* Gonzalez

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

602 The Transition Metals *II, 3*
Structure, bonding and reaction mechanisms of transition metals and their compounds. Applications of Ligand field theory. *(Lec. 3) Prerequisite: CHM 401.* Nelson

604 Semiempirical Molecular Orbital Theory *I or II, 2*
Description of semiempirical molecular orbital calculations and applications to problems of current interest. Use of the computer will be emphasized. *(Lec. 2) Prerequisite: permission of instructor. In alternate years, next offered 1971-72.* Petersen

606 Light Scattering, Applications to Research *I or II, 2*
Thermodynamical and quantum mechanical treatment of radiation scattering from pure liquids and solutions. Emphasis on the application related to molecular structural analysis. *(Lec. 2) Prerequisite: permission of instructor. In alternate years, next offered 1971-72.* Nelson

621 (521) Carbanion Theory *I, 3*
Modern theories of organic chemistry pertaining to carbanion reactions such as hydrogen transfer, displacement, additions to multiple bonds, eliminations, and condensations. *(Lec. 3) Prerequisite: CHM 522 or permission of instructor. In alternate years, next offered 1972-73.* MacKenzie

622 (522) Carbonium Ion Theory *II, 3*
Modern theories of organic chemistry pertaining to carbonium ion formation, stabilization, solvolysis and rearrangement. Material on other acid-catalzyed reactions such as ester and ether hydrolysis and electrophilic aromatic substitutions. *(Lec. 3) Prerequisite: CHM 221, 222.* Abell

623 Free Radical Reactions *I, 3*
Bond homolysis, polymerization, oxidation processes, rearrangements and use of radical intermediates in synthesis. *(Lec. 3) Prerequisite: CHM 222 and 332. In alternate years, next offered 1972-73.* Abell

624 Organic Photochemistry *II, 3*
Theory and mechanisms of organic photochemistry. Excitation, intersystem crossings and photosensitization will be discussed. Essentials of the interaction of light with matter will be reviewed, including selection rules, group theory, the Franck-Condon principle. Mechanisms of reaction and rearrangement are emphasized. *(Lec. 3) Prerequisite: CHM 627. In alternate years, next offered 1972-73.* Vittimberga

625 Advanced Theoretical Chemistry *I, 3*
Theoretical approach to electron interaction in organic molecules. Quantum mechanics and bond orbital theories. *(Lec. 3) Prerequisite: CHM 422.* Vittimberga

627 Physical Methods in Organic Chemistry *I, 3*
Theory and application of some physical methods in organic chemistry, including X-ray diffraction, mass spectrometry and optical rotatory dispersion. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1971-72.* Cheer

634 Advanced Chemical Thermodynamics *II, 3*
Statistical thermodynamics is developed and applied to the calculation of thermodynamic properties. *(Lec. 3) Prerequisite: CHM 433 or permission of department. In alternate years, next offered 1971-72.* Kraus

638 Quantum Chemistry II *II, 3*
Continuation of CHM 537. Includes perturbation theory, the variational principle, time dependent perturbation theory, the helium atom, the hydrogen molecule, Hartree Foch calculations, pi electron systems and the development of the Huckel molecular orbital method. *(Lec. 3) Prerequisite: CHM 537 or equivalent.* Gonzalez

639 Surface Chemistry *I, 3*
Emphasis on contact catalysis. Topics include physical and chemical adsorption, measurement of surface areas, heterogeneous kinetics, physical methods for studying absorbed molecules and the mechanisms of selected catalytic reactions. *(Lec. 3) Prerequisite: CHM 442 and MTH 244.* Gonzalez

641, 642, 643, 644 Graduate Seminar *I and II, 1 each*
Results of detailed literature surveys are presented orally and in writing. Required for candidates for advanced degrees in chemistry. *(Lec. 1)* Staff

651, 652, 653, 654 Research *I and II, 3 each*
Research on an original problem in organic, inorganic, analytical or physical chemistry. A complete literature survey, laboratory work and a detailed report in thesis form to be submitted at conclusion of work. *(Lab. 9) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CHILD DEVELOPMENT AND FAMILY RELATIONS (CDF)

400 Child Development: Advanced Course *I, 3*

403 Human Development During Adulthood *II, 2-3*

450 Family Interaction *I, 3*

460 Family Life Education *II, 3*

480 Children and Families in Poverty *I or II, 3*

497, 498 Special Problems *I and II, 2-4 each*

500 Child Development Seminar *I, 3*
Intensive study of selected topics, such as development of cognitive processes, individual and group differences in the development of language, hereditary factors in physical growth. Review papers prepared by students presented to the class. *(Lec. 3) Prerequisite: CDF 400 or permission of department.* Staff

550 Family Relations Seminar *II, 3*
Intensive study of selected topics, such as maternal, deprivation, child rearing practices and attitudes, homogamy and complementary needs in marital choice. Review papers prepared by students presented to the class. *(Lec. 3) Prerequisite: CDF 355 or permission of department.* Staff

570 Field Experience with Exceptional Children *I and II, 3*
Interdisciplinary seminar and laboratory with observation and supervised projects with exceptional children. Concerned with psychological, physical and social factors pertinent to teaching in child development centers. *(Lec. 1, Lab. 4) Prerequisite: CDF 370 or equivalent and permission of department.* Staff

595, 596 Special Problems *I and II, 3 each*
Intensive reading and research which serves as a basis for a comprehensive report. *Prerequisite: permission of department.* Staff

597, 598 Advanced Study *I and II, 3 each*
Survey of important research contributions significant to understanding of human development and relationships. *(Lec. 3)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

CIVIL AND ENVIRONMENTAL ENGINEERING (CVE)

442 Traffic Engineering *I, 3*

447 Highway Engineering *II, 3*

453 Computer Analysis of Structures *II, 3*

460 Analysis and Design of Metal Structures *I, 3*

465 Analysis and Design of Concrete Structures *II, 3*

470 Water Supply and Treatment *II, 3*

471 Municipal Waste Water Systems *I, 3*

472 Industrial Air Pollution *I or II, 3*

473 Analysis of Air Pollutants *I or II, 3*

478 Solid Waste Disposal and Management *I or II, 3*

481 Soil Behavior *I, 3*

482 Soil Engineering *II, 3*

483 Foundation Engineering *I or II, 3*

491, 492 Special Problems *I and II, 1-6 each*

521 Advanced Strength of Materials *I or II, 3*
Relations between stresses at a point on different planes passing through the point. Stress concentrations and localized stress. Introduction to the analysis of statically indeterminate stresses in which methods involving elastic strain energy are used. Consideration of the plastic analysis of structures. *(Lec. 3)* Staff

524 (or OCE 524) Marine Structural Design *I or II, 3*
Includes the design of marine structures, consideration of marine construction materials, water front structures, ocean towers and underwater structures. *(Lec. 2, Lab. 3) Prerequisite: CVE 351.* McEwen

551 Advanced Structural Analysis *I or II, 3*
Deflections of planar structures using energy concepts and elastic curve principles. Analysis of indeterminate planar structures using advanced techniques. Flexibility and stiffness matrices. *(Lec. 3) Prerequisite: permission of department.* Staff

565 Response of Structures to Dynamic Loads *I or II, 3*
Behavior of materials and components in civil engineering structures. Numerical and exact methods applied to response in the elastic and inelastic range. Matrix analysis. *(Lec. 3) Prerequisite: permission of department.* Staff

570 Sanitary Chemistry *I, 3*
Application of analytical chemistry to analysis of natural waters; physical chemistry and organic chemistry of aqueous media; chemical principles applicable to operations of sanitary engineering. *(Lec. 3) Prerequisite: permission of instructor.* Sussman

571 Sanitary Chemistry Laboratory *II, 3*
Applications of chemical laboratory procedures to

control of water and waste water treatment processes. *(Lec. 2, Lab. 3) Prerequisite: CVE 570.* Sussman

572 Biosystems in Sanitary Engineering *I, 3*
Study of the microorganisms which constitute the biological systems in water pollution, water purification and waste water treatment. Application of principles of microbiology and biochemistry to analysis and design in the fields of sanitary engineering and water resources. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Poon

575 Open Channel Hydraulics *I or II, 3*
Analysis of uniform, critical, varied flow, and unsteady flow in open channels. Principles will be applied to open channel design. *(Lec. 3) Prerequisite: MCE 354.* Poon

584 Principles of Pavement Design *I or II, 3*
Design of flexible and rigid type pavements. Design and control of concrete paving mixes, bituminous concrete paving mixes and current research on pavement design. Emphasis on soil engineering including stabilization, moisture movement and frost considerations. *(Lec. 2, Lab. 3) Prerequisite: CVE 380.* Moultrop and Nacci

585 Soil Stabilization *I or II, 3*
Factors that affect soil stability. Mechanisms of soil stabilization. Design and analysis of stabilized soils. *(Lec. 2, Lab. 3) Prerequisite: CVE 380.* Staff

586 Physico-chemical Properties of Soils *I, 3*
Influence of physico-chemical properties of soils on engineering characteristics and performance. Application of mineralogy, ion exchange and colloidal theory; effect of marine environment; and the nature of soil water. *Prerequisite: CVE 380 or permission of instructor.* Staff

587 Ground Water Flow and Seepage Pressures *I, 3*
Hydrodynamics of fluid flow through porous media. Analytical methods for steady and unsteady seepage in aquifers; theoretical analysis with practical modification of seepage problems involving foundations, drainage structures, earth dams and wells. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Nacci and Wang

596 Numerical Methods in Structural Engineering *I or II, 3*
Methods of successive approximations and numerical procedures in the solution of stress, vibration and stability problems in structural members. Nonuniform members, elastic supports, plates, torsion. *(Lec. 3) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601, 602 Graduate Seminar *I and II, 1 each*
Discussions and presentation of papers based on research or detailed literature surveys. *(Lec. 1) Required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

650 Advanced Structural Analysis *I or II, 3*
Continuation of CVE 551. Analysis of indeterminate trusses, structures with nonprismatic members, and shell and folded plate structures. Investigation of secondary stresses. *(Lec. 3) Prerequisite: permission of department.* Staff

651 Plate Structures *I or II, 3*
Fundamental theories of bending and buckling of plates with practical application to the design of structural plate components of metal and reinforced concrete. *(Lec. 3) Prerequisite: permission of instructor.* Staff

652 Shell Structures *I or II, 3*
Membrane and bending theories of thin shells and their practical application to the design of shell and folded-plate structures of metal and reinforced concrete. *(Lec. 3) Prerequisite: CVE 651 or permission of instructor.* Staff

653 Analysis of Space Structures *I or II, 3*
Analysis of three-dimensional determinate and indeterminate beams, frames, and trusses, by matrix methods. Deflections and indeterminate analysis using virtual work, conjugate structure, and slope deflection procedures. Emphasis is on numerical solutions using the University's digital computer. *(Lec. 3) Prerequisite: CVE 396, 551.* Lavelle

655 Matrix Methods in Structural Analysis *I or II, 3*
Development of finite-element methods of structural analysis. Application to stress problems and to plate and shell structures. *(Lec. 3) Prerequisite: permission of instructor.* Staff

673 Theory of Water Purification and Treatment *I, 3*
Principles of modern water purification and engineering practices. Aeration, deodorization, sterilization, coagulation, filtration, water softening, iron removal, disinfection and corrosion control. *(Lec. 3)* Campbell

674 Sanitary Engineering Laboratory *II, 3*
Advanced phases of sewage treatment and purification including sludge digestion, sludge gas analysis, biochemical oxygen demand, conditioning of sludge, activated sludge, sewage trickling filters and chemical precipitation. *(Lec. 2, Lab. 3)* Poon

675 Sanitary Engineering Design *I, 3*
Functional design of modern water treatment plant providing treatment of water for domestic and industrial consumption. *(Lec. 1, Lab. 6)* Poon

676 Sanitary Engineering Design *II, 3*
Functional design of modern sewage treatment works providing treatment of sewage. *(Lec. 1, Lab. 6)* Campbell

677 Stream and Estuarine Analysis *I or II, 3*
Functionals and mathematical concepts of physical and biological factors applied to the evaluation of the pollution capacity of streams and estuaries. *(Lec. 3) Prerequisite: MTH 244.* Campbell

678 Industrial Waste Water Treatment *I or II, 3*
Advanced considerations of industrial waste disposal problems of major waste producing industries, including the study of waste producing processes, composition of waste waters, treatment methods, and in-plant abatement techniques. *(Lec. 3) Prerequisite: permission of instructor.* Poon and Sussman

679 Treatment of Municipal Wastes *I or II, 3*
Theory and mathematical concepts of physical, chemical, and biological oxidation processes applied to the clarification and purification of municipal waste waters. *(Lec. 3) Prerequisite: permission of instructor.* Poon

681 Advanced Soil Mechanics *I, 3*
Index properties and physical properties of soils. Laboratory and field procedures for soil identification. Permeability and flow of water through soils. Compressibility characteristics of soils and consolidation theories as applied to settlement analysis. *(Lec. 2, Lab. 3) Prerequisite: CVE 521.* Nacci or Wang

682 Advanced Soil Mechanics *II, 3*
Stress analysis. Elastic theory of stress distribution in soils. Application of consolidation theory. Shearing phenomena in soils with application to bearing capacity, earth pressure and slope stability. Pile foundation analysis. Special topics. *(Lec. 3)* Nacci or Wang

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problems. Credits not to exceed a total of 12.) Prerequisite: permission of department.* Staff

696 Numerical Methods in Structural Engineering *I or II, 3*
Continuation of CVE 596. Applications of relaxation, finite differences, ordinary and partial differential equations to blast loads on structures, bending of plates, and buckling of beams. *(Lec. 3) Prerequisite: CVE 596 or permission of instructor.* Staff

COMMUNITY PLANNING (CPL)

410 Fundamentals of Urban Planning *II, 3*

411 Introduction to Community Planning *I, 1*

503 Urban Planning and Politics in the Metropolis *I, 3*
Significance and impact of urban planning on growth and betterment of cities and metropolitan areas. The planning process as it relates to the formulation of community development policies and the institutional framework from which they are produced. *(Lec. 3) Prerequisite: PSC 422 or 460, or equivalent.* Foster

506 Market and Non-market Decision Making *I, 3*
Interdisciplinary approach to the determination of human needs and wants as they relate to planning goals and objectives. A framework for the prediction of behavior using the value structure of a culture or subculture; appropriate tools of measurement for qualitative data. *(Lec. 3) Prerequisite: permission of instructor.* Jeffrey

531 (or REN 531) Land Economics *II, 3*
Land as a factor of production, its uses for economic and social purposes, including urban and recreational uses. Property and water rights, zoning, tenure. *(Lec. 3) Prerequisite: REN 105, or ECN 125, or permission of instructor.* Jeffrey

551, 552 Problems in Planning Practice *I and II, 3 each*
Individual research, study, and reporting on a phase of planning practice to be chosen in consultation with instructor. Familiarizes students with the field operation of planning and introduces them to the practical difficulties of research, community involvement, and final reporting. Problems of planning with inner-city communities. *(Lab. 6) Prerequisite: permission of instructor.* Johnson

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

603, 604 Seminar in Contemporary U.S. Environment *I and II, 8 each*
Comprehensive survey of structural change in American society and its environmental settings, as well as the universal perspectives in terms of which technical planning skills must be developed and employed. Seminars, tutorials, and assigned research topics. *(Lec. 6, Tut. 2)* Brooks, Foster, Hammerschlag, Jeffrey and Schenck

611 Studio A, the Comprehensive Planning Process I *I, 4*
Understanding of the physical environment and application of analytical planning studies. Topics include the planning process, planning tools and techniques, and inventory procedures: population estimation and forecasting, economic analysis, topography, soils and climate, land use analysis, transportation analysis, operations and facilities in the public sector. Methods of analysis applied in a laboratory problem involving a specified urban area. *(Lec. 3, Lab. 3)* Staff

612 Studio B, the Comprehensive Planning Process II *II, 4*
The community plan: community facilities, future land use plan, economic development plan and general plan implementation. Functional requirements of physical elements and their relationships in space including comprehensive policies development plan. *(Lec. 3, Lab. 3)* Downe and Nadler

621 Studio C, Problems in Planning Use Requirements *I, 6*
Kinds of activities in urban areas and their land use requirements. Industrial and commercial activities, housing requirements and neighborhood design, public facilities, utilities and site development. Special emphasis on urban planning and design for one or more elements in detail within a general plan framework. *(Lec. 3, Lab. 6)* Staff and visiting critics

622 Studio D, Problems in Planning Programming *II, 4*
Development of a project plan and the various tools for effectuating planning proposals. Lecture and discussion includes consideration of urban renewal, community action programs, capital budgeting, federal, state and local legal requirements, and preparation of an appropriate planning report. *(Lec. 3, Lab. 3)* Brooks and Hammerschlag

631 Planning Law Seminar *I, 3*
General review and discussion of legal principles and thought concerned with property rights, political power, and the legal aspects pertinent to the planning and development of public and private activities. *(Lec. 3)* Brooks

633 Advocacy Planning *I or II, 3*
Relationships between residents of an urban slum and public officials in governmental agencies; "citizen participation" in urban renewal areas, enforcement of housing laws, selected problems of city schools, public assistance, and civil disobedience. Relationships in each of these areas will be reviewed on the basis of statutory, administrative, or contractual material. *(Lec. 3)* Staff

636 Planning Seminar in Urban Design *I, 3*
Significant concepts of historical and contemporary urban form ranging in scale from the city as a whole to architectural detail of public projects. Use of slides and films to illustrate the visual impact and importance of excellence in design. *(Lec. 3)* Hammerschlag

641 Research Methodology *I, 2*
Lectures and seminars on the philosophy, conduct, and reporting of research, and types of design and methodology appropriate to a variety of planning problems. Recent research techniques, including computer mapping. Selection and critique of problem and design in preparation for thesis. Lectures and seminars to meet the needs of individual students in planning. *(Lec. 2) Prerequisite: an elementary statistics course.* Nadler

642 Plan Implementation *I or II, 3*
Survey of the tools of plan implementation, including public tools such as zoning, subdivision control, capital budgets, renewal, taxation, other federal and state programs, and private tools such as mortgaging and easements. Readings, discussion, and special problems in the application of the tools. *(Lec. 3) Prerequisite: CPL 631.* Brooks

651, 652 Planning Seminar *I and II, 3 each*
Group and/or individual investigation of special problems in city and regional planning. Staff

661 Seminar in Planning Theory *I, 3*
Critical survey of current theories and contemporary planning concepts. The logic of the process of city and regional planning, its basic axioms and postulates, focusing on such elements as value, fact, opinion, bias, goal, symbol, dogma, and intuition. Models for choice-making and resource-allocation as contributions to systematic planning theory. *(Lec. 3)* Staff

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *Prerequisite: permission of instructor.* Staff

COMPUTER SCIENCE (CSC)

410 Introduction to Computer Science and Algorithmic Processes *I and II, 3*

411 Computer Organization and Programming *I, 3*

412 Programming Systems *II, 3*

413 Data Structures *I, 3*

491, 492 Problems in Computer Science *I and II, 1-3 each*

500 Scientific Applications of Digital Computers I *I, 3*
Algorithms, techniques, and practical procedures for digital computers related to well-known applications of numerical methods. Approximation methods, numerical quadrature, solution of differential equations, zero's of functions, error analysis. Examples, using the University computer. *(Lec. 3) Prerequisite: MTH 243, CSC 410 and permission of instructor.* Carrano

502 Theory of Algorithmic Languages and Compilers *II, 3*
Formal description of procedure-oriented languages and the techniques used in translating algorithms written in these languages into computer programs. *(Lec. 3) Prerequisite: credit or concurrent registration in CSC 413.* Bass

505 Design of Digital Circuits
See Electrical Engineering 505.

512 Advanced Programming Systems *I, 3*
Advanced analysis of monitor and executive systems. Several topics from CSC 412 will be studied in greater depth, along with recent developments in the field. *(Lec. 3) Prerequisite: CSC 412 and 413.* Bass and Tetreault

515 Theory of Computation *II, 3*
Turing machines, recursive functions, Shepardson-Sturgis machines, Universal Turing machines, Church's thesis, standard indexing, decision and halting problems, recursive sets, recursively enumerable sets, automata, computational complexity, Post productions. *(Lec. 3) Prerequisite: CSC 412 and permission of instructor.* Bass

525 (or IDE 525) Simulation *II, 3*
Introduction to simulation. Discrete simulation models. Comparison of discrete change simulation languages. Simulation methodology including generation of random variates, design of simulation experiments for optimization, analysis of generated data, and validation of models and results. Selected applications of simulation. *Prerequisite: CSC 410 and 6 credits in statistics. In alternate years, next offered 1971-72.* Carney

551 Scientific Applications of Digital Computers II *II, 3*
Algorithms, techniques and practical procedures for digital computers emphasizing linear computations and statistical applications. Monte Carlo methods. Matrix calculations, simultaneous linear equations, matrix inversion. Least square analysis, multiple regression. Characteristic value problems. *(Lec. 3) Prerequisite: MTH 215 and CSC 410 or equivalent and permission of instructor.* Hemmerle

591, 592 Problems in Computer Science *I and II, 1-3 each*
Advanced work in computer science. Courses will be conducted as seminars or as supervised individual projects. *(Lec. or Lab. arranged)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ECONOMICS (ECN)

400 Economics Seminar *I or II, 3*

427 Intermediate Economic Theory: Income and Employment *I or II, 3*

428 Intermediate Economic Theory: Pricing and Distribution *I or II, 3*

438 International Trade and Policy *I or II, 3*

451, 452 Assigned Work *I and II, 3 each*

463 Economic Growth and Development *I or II, 3*

464 Comparative Economic Systems *I or II, 3*

475 Introduction to Quantitative Economic Analysis *I or II, 3*

503 Development of the United States Economy *I, 3*
The process of economic development, as illustrated by the economy of the United States. *(Lec. 3) Prerequisite: ECN 126, and either HIS 141, 142 or ECN 302, or permission of instructor.* Haller

512 History of Economic Analysis *II, 3*
Advanced work which examines formative developments in economic thought from classical political economy to modern welfare economics. Emphasis will be placed on relationships between doctrines and their institutional setting. *(Lec. 3) Prerequisite: permission of instructor.* Schurman

515, 516 Economic Research *I and II, 3 each*
Independent research. Staff

527 (or REN 527) Macroeconomic Models *I, 3*
Economic relationships expressed using mathematical concepts, static and dynamic models of aggregate economic behavior will be developed and analyzed. *(Lec. 3) Prerequisite: ECN 427 and 475, or equivalent or permission of instructor.* Paulaha

528 (or REN 528) Microeconomic Models *I, 3*
Microeconomic concepts such as demand, production, and cost functions will be expressed in a mathematical framework. Theories of consumer, firm and industry economic behavior will be discussed and analyzed. *(Lec. 3) Prerequisite: ECN 428 and 475, or equivalent or permission of instructor.* Labys

532 Industrial Organization and Public Policy *II, 3*
Theoretical and empirical analysis of the structure of industrial markets; the behavior and performance of business firms in the American economy; the government-business relationship and its effect on the formulation of public economic policy. *(Lec. 3) Prerequisite: ECN 337 or permission of instructor.* Dirlam

543 Public Finance and Fiscal Policy *I, 3*
Analysis of private wants and public needs and the economic share of each serves as an introduction to a searching examination of such selected federal and federal-state fiscal problems as budgetary theory and procedures, tax theory and reform, debt and debt management policy. *(Lec. 3) Prerequisite: ECN 342 or permission of instructor.* Starkey

552 Monetary Theory and Policy *II, 3*
Analysis of structure and functioning of monetary and banking systems; discussion of contemporary

monetary theories; evaluation of monetary policies. *(Lec. 3) Prerequisite: ECN 334 or permission of instructor.* Barnett

566 Economic Planning and Public Policy in Developing Nations *II, 3*
Resource and financial planning in public and private sectors of developing nations with emphasis on planning tools, allocation of domestic and foreign resources, and on national economic policies. *(Lec. 3) Prerequisite: ECN 427 and 463 or 464, or equivalent, or permission of instructor.* Prakash

~~575~~

576 Econometrics I *II, 3*
Application of statistics and mathematics to economic analysis. Implications of assumptions required by statistical methods for testing economic hypotheses will be fully explored. Current research applications of econometric methods will be examined and discussed. *(Lec. 3) Prerequisite: ECN 126 or 475 and 6 credit hours of statistics, or permission of instructor.* Labys

577 Econometrics II *II, 3*
Continuation of Econometrics I. *(Lec. 3) Prerequisite: ECN 576 or permission of instructor.* Lampe

595 (or PSC 595, GEG 595, SOC 595 or REN 595) Problems of Modernization in Developing Nations *II, 3*
Varying regional emphasis. Selected problems in the environmental complex, agricultural systems, population dynamics, distribution systems, political integration, urbanization-industrialization, popular participation, integrated theories of modernization. *(Lec. 3) Prerequisite: permission of instructors.* Brand (Geography), Lampe (Resource Economics), Landberg (Sociology and Anthropology), Milburn (Political Science), Prakash (Economics), and Suzawa (Economics)

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

627 Advanced Macroeconomic Theory *II, 3*
Post-Keynesian macroeconomic theory, growth and cyclical models, current development in national income analysis. *(Lec. 3) Prerequisite: ECN 427 and 428 or permission of instructor.* Paulaha

628 Advanced Microeconomic Theory *II, 3*
Neoclassical value and distribution theory. Theories of imperfect competition, general equilibrium theory and dynamic analysis. *(Lec. 3) Prerequisite: ECN 427 and 428 or permission of instructor.* Labys

675 Mathematical Economics II
See Resource Economics 675.

690 National Income *I, 3*
Advanced macroeconomic theory. *(Lec. 3) Prerequisite: ECN 126 or 990 or permission of instructor.* Latos

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

990 Principles of Economics *I and II, 3*
Survey of micro- and macroeconomic theory. *(Lec. 3) Graduate credit for matriculated MBA students only.* Staff

EDUCATION (EDC)

401 Development and Utilization of Instructional Materials *I and II, 3*

403 History of Education *I, 3*

407 Philosophy of Education *II, 3*

409 Health Aspects of Aging *I and II, 3*

410, 411 Seminar and Supervised Field Practicum in Education of the Aging *I and II, 3 each*

424 Teaching of Reading *I and II, 3*

427, 428 Child and Curriculum I and II *I and II, 3 each*

430 Methods and Materials in Secondary Teaching *I and II, 3*

441 Methods and Materials of Teaching Business Subjects *I, 4*

444 Teaching of Agriculture *I, 3*

450 Introduction to Guidance *I and II, 3*

478, 479 Problems in Education *I and II, 1-3 each*

484 Supervised Student Teaching *I and II*

485 Seminar in Teaching *I and II, 3*

503 Education in Contemporary Society *I and II, 3*
Analysis of contemporary social and economic characteristics of society that affect education. Evaluation of school as a social institution, with emphasis on the role education plays in progressive development of democratic society. *(Lec. 3)* Hagey

505 Principles and Practices of Leadership Development for Youth and Community Programs *I or II, 3*
Philosophy and interrelationships of vocational-technical and general education with extension education and other community educational agencies; leadership concepts and implications; methods and techniques

for increasing the effectiveness of organizations. *(Lec. 3) Prerequisite: permission of instructor.* McCreight

506 Methods of Teaching Home Economics *I or II, 3*
Selection, organization and use of instructional materials, methods and techniques of teaching home economics. *(Lec. 3)* P. Kelly

507 Curriculum Study in Home Economics *I or II, 3*
Developing a philosophy and acquiring findings about students, school programs, communities, and current trends as a basis for constructing a scope and sequence plan for a homemaking program. Units of work developed for various age groups. *(Lec. 3)* P. Kelly, May, MacKenzie

508 Supervision of Home Economics *I or II, 3*
Primarily for homemaking teachers who wish to become supervising teachers and work with college student teachers majoring in home economics teacher education. *(Lec. 3)* P. Kelly, MacKenzie

509 Seminar in Home Economics Education *I or II, 3*
Critical study of research literature and research techniques appropriate to solution of problems in home economics. *(Lec. 1-3)* Cusack, P. Kelly

~~510-511~~

514 Current Trends in Elementary Education *I and II, 3*
For teachers and administrators, the most effective use of instructional materials, media of communication, and personnel in elementary school. *(Lec. 3) Prerequisite: EDC 529 or permission of department.* Nally

5-518

520 Teaching of Arithmetic *I, 3*
Designed for the experienced teacher, examination of the principles underlying the teaching of arithmetic in the elementary school, together with the comprehensive survey of materials and methods available for the classroom teacher of arithmetic. *(Lec. 3) Prerequisite: senior or graduate standing.* Nally

523 Physical Factors Related to Reading Disability *I and II, 3*
Investigation and evaluation of various physical factors contributing to reading disability, such as visual, hearing, and speech deficiencies, motor adjustments, glandular deficiencies, general health, brain damage and congenital word-blindness, and lateral dominance. Screening tests and instructional procedures for use in various areas. *(Lec. 3) Prerequisite: EDC 561, 562 and permission of department.* Staff

526 Teaching the New Grammars *I, 3*
Implications of the newer grammars for the teaching of English, including a review of the history of grammar, traditional grammar, and as needed, the linguistic theory necessary to an understanding of the newer grammars. *(Lec. 3) Prerequisite: graduate standing and/or certification to teach English.* DiBiasio

528 Teaching Language Arts *II, 3*
Phonics, grammar, lexicography, and usage in American English for the elementary school classroom teacher. Presentation, use, evaluation, and development of methods and materials for students in the classroom. *(Lec. 3)* DiBiasio

529 Foundations of Educational Research *I and II, 3*
Analysis of the current major research approaches to educational problems with emphasis on interpreting published research involving the language of statistics. Functional skills in basic descriptive statistics needed prior to enrolling. *(Lec. 3)* MacMillan and Soderberg

531 (or FNS 531) Teaching of Nutrition *I or II, 3*
Development of curriculums in nutrition education for teachers in grades K through 12 and appropriate programs for community nutrition educators. Emphasis on innovative teaching techniques using latest nutrition knowledge. *(Lec. 3) Prerequisite: graduate standing and permission of department.* Dymsza and MacKenzie

534 Mathematics in the Secondary School *II, 3*
Deals with the implementation of a modern mathematics program in the secondary school through a study of modern mathematics concepts, experimental programs, and instructional planning. *(Lec. 3) Prerequisite: 15 credits in mathematics.* Croasdale

541 Reading in Secondary School Content Subjects *II, 3*
Designed especially to help junior and senior high school teachers to cope with the problems of the teaching of reading in their subject areas. *(Lec. 3) Prerequisite: EDC 430 or permission of department.* Staff

550 Educational and Vocational Information *I and II, 3*
Classification and description of jobs and industries, occupational trends in relation to socio-economic changes. Experience in use of occupational information in counseling groups and individuals. Field trips to industries. *(Lec. 3) Prerequisite: EDC 450 and graduate standing.* Staff

551 Counseling Techniques *I and II, 3*
Foundations of theory and practice, with special emphasis upon approaches to counseling with children and youth in educational settings, primarily designed for the preparation of the school counselor. *(Lec. 3) Prerequisite: EDC 550 and graduate standing.* Gunning

552 Group Procedures in Guidance *I and II, 3*
Basic principles and techniques in human behavior in groups with emphasis on a fundamental approach in guidance, counseling, and education. How group approaches based on scientific research and study can be

applied to guidance and personnel programs with particular reference to articulation and orientation, educational and occupational planning and group counseling. *(Lec. 3) Prerequisite: EDC 551.* Pascale

553 Counseling Practicum *I and II, 3*
Advanced course in counseling. Multiple counseling sessions using tapes and supervised observation will be included to help measure individual assessment of growth and competence. *(Lec. I, Lab. 5) Prerequisite: EDC 551 and permission of department.* Staff

554 Individual Appraisal in Guidance *II, 3*
Nature of the appraisal process and data essential to understanding the educational, vocational and social needs of persons. Emphasis is upon the team approach in pupil personnel services and the use of the case materials. *(Lec. 3) Prerequisite: EDC 553 and PSY 434.* Gunning

555, 556 Supervised Field Work and Seminar in Guidance and Counseling *I and II, 3 each*
Clinically oriented to give students an opportunity in selected school systems to apply and integrate guidance and counseling theories and skills. 200 clock hours of laboratory experience required in addition to the seminar for the total of two semesters' work. *(Lec. 2, Lab. 3) Prerequisite: EDC 554 and permission of department.* Gunning and Pascale

557 Principles and Practices of Student Personnel Services in Higher Education *I and II, 3*
Survey of the historical, psychological, organizational, and educational factors which have evolved and combined to form student personnel work. *(Lec. 3) Prerequisite: EDC 553 and 554.* Quinn

558 Organization and Administration of Student Personnel Services in Higher Education *II, 3*
Systematic analysis of current practices in the alignment and operation of student personnel services, with continuing review of their interrelationships to the total educational program. *(Lec. 3) Prerequisite: EDC 553, 554 and 557.* Quinn

561 Analysis of Reading Disabilities *I and II, 3*
Causes of reading difficulties and the administration of diagnostic reading tests. Emphasis on construction and use of informal tests and standardized measures. Practice in analyzing data from case histories and in making individual case studies. *(Lec. 3, Lab. 2) Prerequisite: PSY 434, EDC 424 or 541, and permission of department.* McGuire

562 Techniques in Remedial Reading *I and II, 3*
Specific practices effective in teaching of remedial reading in both the regular classroom and remedial reading clinics. Analysis of published materials. Methods of building new materials with discussion and demonstration of their practical application. *(Lec. 3, Lab. 2) Prerequisite: EDC 561 and permission of department.* McGuire

563 Reading Programs for the Disadvantaged *I and II, 3*
Impact of the culture of the disadvantaged upon the child and his response to learning and the school, with special emphasis on reading and the adjustment of reading materials and methods to individual socio-economic-cultural differences. *(Lec. 3)* Bumpus

564 Beginning Reading Programs *I and II, 3*
Analysis of various approaches to reading instruction (other than the basal method) including phonetic, linguistic, language arts, programmed, and other experimental systems. Currently available materials will be analyzed and classified. *(Lec. 3) Prerequisite: EDC 424.* Aukerman

565 Analysis and Evaluation of Current Research in Reading *I, 3*
Concise analysis of the latest research in reading. Criteria for the evaluation of reading research data as it applies to both teacher and learner. Location and application of current research to reading programs. *(Lec. 3) Prerequisite: EDC 562, 529 and permission of department.* Aukerman

566, 567 Practicum in Reading *I and II, 3 each*
Supervised case studies, practicum and seminar reports on an individual reading project at either elementary or secondary level. Lecture and/or laboratory. 120 hours plus seminar. *Prerequisite: permission of department.* McGuire

570 Elementary School Curriculum *II, 3*
Modern curriculum in the elementary school with emphasis on the needs of children. The course covers language, arts, social studies, science, arithmetic and special subjects. *(Lec. 3) Prerequisite: EDC 503, 529 or equivalent.* Kelly

571 The Secondary School Curriculum *II, 3*
Intensive study of basic principles and procedures utilized in developing curriculum materials. Emphasis given to content of all curriculum areas in junior and senior high schools. *(Lec. 3) Prerequisite: EDC 503, 529.* Whitcomb

572 Cooperative Supervision *I and II, 3*
Analysis of function, principles and techniques of democratic cooperative supervision of teachers and other school officials. Application of these principles to supervisory problems of principals, heads of departments, special supervisors and critic teachers. *(Lec. 3) This course meets certification requirements for Critic Teacher Certificate.* Heisler

573 Seminar—Educational Research *I and II, 1*
For master's degree candidates developing a thesis. Student presentations of thesis topics, research designs, and research findings. Attention given to the orderly development of research studies. Graduate students who require assistance with their theses problems must enroll for this course unless they are en-

rolled for thesis credit. *Prerequisite: registration for thesis.* Staff

574 Current Trends in Secondary Education *I and II, 3*
Effective use of instructional materials, media of communication, and organization of personnel and current research. *Prerequisite: EDC 529, 571 or permission of department.* Staff

575, 576 Supervised Field Study and Seminar in Elementary or Secondary Education *I and II, 3 each*
Two semester sequence for non-thesis candidates, composed of lectures, seminars and field work. Candidates plan and carry out a field study project approved by the instructor. The completed field study project report must be successfully defended during seminar. *Prerequisite: EDC 503, 570, or 529 and 571, or permission of instructor.* Kelly and Staff

577 Organization and Administration in Elementary School *I, 3*
The functions and duties of elementary school principals. *(Lec. 3) Alternate years, next offered 1971-72.* Kelly

580 Organizing and Administering Youth Programs *I or II, 3*
Planning, organization, instruction and supervision of youth programs. Includes vocational-technical and general education in their relationship to extension education and other community agencies. Youth guidance and psychological development emphasized. *(Lec. 3) Prerequisite: EDC 505 or permission of instructor.* McCreight

581 Organizing and Administering Programs of Continuing Education for Adults *I or II, 3*
Planning, organization, instruction and supervision of continuing education for adults in both vocational-technical and general education as conducted by extension education and other community agencies. *(Lec. 3) Prerequisite: EDC 505 or permission of instructor.* McCreight

582 Curriculum Development in Vocational-Technical and Extension Education *I, 3*
Principles and processes involved in the basic concepts effecting vocational-technical and extension education programs. Emphasis is given to planning, execution and evaluation. *(Lec. 3) Prerequisite: EDC 580 or 581 or permission of instructor.* McCreight

583 Analyzing Community Needs and Resources for Youth and Adult Programs *I, 3*
Designed to help the student function effectively in the role of change-agent in a community setting. Concepts of goals, change, power and community will be considered in relation to the student's community experiences. *(Lec. 3) Prerequisite: permission of instructor.* Bromley

584 The Adult and the Learning Process *I and II, 3*
Examination of the adult as a learner with emphasis on the factors that affect adult learning. *(Lec. 3) Prerequisite: EDC 581 or permission of instructor.* Bromley

585 Seminar on Leadership Development for Youth and Community Programs *II, 3*
Students will participate in a non-structured group to observe the emergence of leadership and the effects of individual behavior on self and others. *(Lec. 3) Prerequisite: permission of instructor.* Bromley

586, 587 Problems in Education *I and II, 3 each*
Advanced work for graduate students in education. Courses conducted as seminars or as supervised individual projects. *(Lec. or Lab.) Prerequisite: permission of department.* Staff

588, 589 Supervised Field Practicum and Seminar in Youth, Adult, and Community Education *I and II, 3 each*
Designed to provide students an opportunity in selected clinic systems to apply leadership principles and practices. 200 clock hours of practicum are required in addition to the seminar. *(Lec. 2, Lab. 3) Prerequisite: EDC 582, 583, or 584 and 529, or permission of instructor.* Bromley, McCreight

590 Social Issues in Urban Education *II, 3*
Current social problems with which teachers are confronted in urban education. Emphasis is placed upon current problems from the perspective of sociology, social welfare, psychology and education. Field trips, visiting lecturers and sensitivity training will all be utilized in the development of issues. *(Lec. 3) Prerequisite: EDC 102.* Staff

594 Organization and Supervision of Reading Programs *II, 3*
The various roles of the reading specialist in relation to the other line-staff personnel will be discussed. Problems concerning the orientation of new teachers, reading research and development, inservice programs, and community support will be explored. *(Lec. 3) Prerequisite: EDC 561, 562.*

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ELECTRICAL ENGINEERING (ELE)

411 Microwave and Quantum Electronics *I, 3*

413 Microwave and Quantum Electronics Laboratory *I, 3*

417 Direct Energy Conversion *II, 3*

427 Electromechanical Devices and Systems *I, 3*

431 Electrical Engineering Materials I *I, 3*

432 Electrical Engineering Materials II *II, 3*

433 Electrical Engineering Materials and Direct Energy Conversion Laboratory *II, 3*

436 Communication Systems *II, 3*

437 Introduction to Photo-electronic Devices *I and II, 3*

443 Electronics II *I, 5*

444 Electronics III, Pulse and Digital Circuits *II, 4*

457 Feedback Control Systems *I, 3*

458 Systems Laboratory *II, 3*

481, 482 Biomedical Engineering Seminar *I and II, 1 each*

484 Modeling of Physiological Systems *II, 3*

491, 492, 493 Special Problems *I and II, 1 each*

501 Linear Circuit Theory *I, 3*
Transform analysis of discrete and distributed systems, functions of a complex variable, state variable description of systems and time domain analysis, matrices and linear spaces, feedback concepts. *(Lec. 3)* Staff

505 (or CSC 505) Design of Digital Circuits *I, 3*
Analytical development of methods for digital circuit design. Computer arithmetic, control, and memory elements. Design of sequence generators. Special purpose digital circuits for performing numerical operations such as integration, smoothing and filtering. *(Lec. 3)* Tufts

506 Digital Signal Processing *II, 3*
Digital representations of signals and noise, digital filtering and spectral analysis, design of digital circuits for signal parameter estimation and signal detection. *(Lec. 3)* Tufts

509 Systems with Random Inputs *I or II, 3*
Discrete and continuous linear systems with random inputs. Introduction to random processes in the context of linear systems. Applications to detection, smoothing and prediction. *(Lec. 3) Prerequisite: knowledge of differential equations, linear systems and transform methods.* Staff

511 Electromagnetic Fields *I, 3*
Review of electrostatics and magnetostatics. Maxwell's equations, wave propagation in dielectric and conducting media. Boundary phenomena. Radiation from simple structures. Relations between circuit and field theory. *(Lec. 3)* Staff

514 Microwave Electronics *I or II, 3*
Electronic engineering at microwave frequencies, microwave circuit theory, impedance transformation and matching, passive microwave devices, microwave tubes, semiconductor microwave electronics, microwave masers, parametric amplifiers. *(Lec. 3) Prerequisite: ELE 411 concurrently or permission of instructor.* Daly

515 Quantum Electronics *I or II, 3*
Laser engineering and applications, interaction of radiation with atoms, optical resonators, electro-optic modulation, harmonic generation, parametric oscillation and frequency conversion, noise in laser amplifiers and oscillators. *(Lec. 3) Prerequisite: PHY 341 or permission of instructor.* Daly

516 Planetary Electrodynamics *I or II, 3*
An introduction to the description and theory of natural electric and magnetic phenomena on the earth and in the solar system such as lightning, natural geomagnetic and interplanetary magnetic fields, origin and properties of ionospheres, the "solar wind" and natural radio noise. *(Lec. 3) Prerequisite: permission of instructor.* Polk

517 Magnetofluidmechanics
See Mechanical Engineering 517.

531 Solid State Engineering I *I and II, 3*
Periodicity of solids; dielectric, thermal, optical and electro-magnetic properties of electronically interesting solids. *(Lec. 3) Prerequisite: ELE 431 or equivalent.* Staff

532 Solid State Engineering II *I and II, 3*
Semiconductor physics, transport properties. Applications including solid state lasers, piezoelectric, ferroelectric and magnetic devices. *(Lec. 3) Prerequisite: ELE 531 or equivalent.* Staff

535 Transistor Circuits *I and II, 3*
Semiconductors, characteristics of junction transistors. Analysis and design of single and multistage amplifiers including feedback. High frequency considerations, applications to systems. *(Lec. 3)* Staff

536 Semiconductor Electronics *I or II, 3*
Theory and technology of semiconductor devices. Junction, field effect, optoelectronic and microwave devices. Integrated circuits. *(Lec. 3) Prerequisite: ELE 431 or equivalent.* Sadasiv

537 Electronic Instrumentation and Control Circuits *I and II, 3*
Analysis and design of special amplifiers, operational circuitry, measurement of non-electrical quantities, transducers. *(Lec. 3)* Staff

538 Principles of Remote Sensing *I or II, 3*
The theory and techniques of remote sensing including spaceborne photometry and radiometry. Applications will be selected from the following topics: plan-

etary atmospheres, geology and earth resources, and environmental problems. *(Lec. 3) Prerequisite: ELE 323, PHY 406, or permission of instructor.* Zirkind

539 Infrared Imaging Techniques *I or II, 3*
Elemental detectors and their application in radiometers and scanners. Principles of infrared imaging devices. Thermal radiation and its propagation through the atmosphere. *(Lec. 3) Prerequisite: ELE 437 or equivalent.* Zirkind

545 Optimization and Variational Problems in Electrical Engineering *I or II, 3*
Application of variational and approximation techniques to boundary value field problems, extremal control of dynamic systems, and optimization in communication theory. Performance criteria, Hamilton-Jacobi theory; Ritz and Galerkin methods; Weinstein and Bazly methods for determining the upper and lower bounds of eigenvalues in engineering problems; optimal filter theory. *(Lec. 3) Prerequisite: ELE 501 or 511 or permission of instructor.* Poularikas

561 Information Transmission *I or II, 3*
Introduction to information theory. Discrete and continuous communications channels. Techniques for coding and decoding information. *(Lec. 3) Prerequisite: ELE 509 or equivalent.* Kelley and Spence

565 Fundamentals of Signal Theory *I and II, 3*
Concepts of signal expansions in sets of orthogonal functions other than Fourier, classification of signal types. Optimum representation vocabulary, matrix analysis. *(Lec. 3) Prerequisite: ELE 501 or equivalent.*

571 (or OCE 571) Underwater Acoustics I *I, 3*
Wave equation, stress-strain relations, energy, pressure and particle velocity. Ray theory, normal modes, refraction, reflection, layered media, scattering, with particular emphasis on sound propagation in the ocean. Acoustic properties of the sea, properties of solids. *(Lec. 3)* F. Middleton

575 Electroacoustical Engineering I *I and II, 3*
Theory and design of electroacoustic transmission channels and the psychoacoustic aspects of their use for high-quality music transmission. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Etzold

576 Electroacoustical Engineering II *I and II, 3*
Storage of sound, studio-design and acoustical measurements. *(Lec. 2, Lab. 3) Prerequisite: ELE 575.* Etzold

586 Biomedical Electronics I *I and II, 3*
Design and analysis of biomedical instrumentation and transducers for both implantation and external use. Direct current and wide band amplifiers, counter, trigger and timing circuits. *(Lec. 3) Prerequisite: ELE 342 or equivalent.* Hubbell

587 Biomedical Electronics II *I and II, 3*
Principles of bio-telemetry. Measurement of cardiovascular, metabolic and respiratory activity under dynamic conditions. Use of ultrasonics and microwaves in measuring properties of physiological tissue. *(Lec. 3) Prerequisite: permission of department.* Hubbell

588 Biomedical Engineering I *I and II, 3*
Origin and characteristics of electrical potentials, transport and diffusion phenomena, dielectric and thermal properties of physiological material. Principles of electromyography, electrocardiography, and electroencephalography. Neural pathways and synaptic transmissions. *(Lec. 3) Prerequisite: permission of department. Taught in cooperation with zoology and pharmacology departments.* Staff

589 Biomedical Engineering II *I and II, 3*
Study and analysis of cardiovascular, respiratory, neurological, muscular, gastrointestinal and urinary systems using mathematical tools, electronic and analog models. Use of computers for biomedical data analysis and processing. Correlation and auto correlation techniques. *(Lec. 3) Prerequisite: permission of department. Taught in cooperation with zoology and pharmacology departments.* Staff

591, 592 Special Problems *I and II, 1-3 each*
Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601, 602 Graduate Seminar *I and II, 1 each*
Seminar discussions including the presentation of papers based on research or detailed literature surveys. *(Lec. 1) Attendance is required of all students in graduate residence, but a maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

605 Non-linear System Analysis *I and II, 3*
Iteration and perturbation techniques, phase plane and state space concepts, Liapunov's direct method, stability criteria for non-linear systems. *(Lec. 3) Prerequisite: ELE 501 or equivalent.* Lindgren

613 Waveguides and Resonators *II, 3*
Theory of homogeneous isotropic waveguides and cavity resonators. *(Lec. 3) Prerequisite: ELE 511 or equivalent.* Daly or Poularikas

615 Antennas and Radio Propagation *I and II, 3*
Analysis of simple linear and area antennas. Antennas arrays. Diffraction theory. Introduction to radio propagation. *(Lec. 3) Prerequisite: ELE 511 or equivalent.* Spence or Polk

616 Advanced Topics in Electromagnetic Theory *II, 3*
Electromagnetic theory of inhomogeneous and aniso-

tropic media. Ferrite devices. Introduction to the theory of plasmas. Ionospheric radio propagation. *(Lec. 3) Prerequisite: ELE 511, 613, 615 or equivalent.* Daly or Polk

631 Electronics of Solids I *I and II, 3*
Properties of conductors, semiconductors, and insulators from quantum mechanical principles. Band theory of solids, superconductivity, thermoelectricity. *(Lec. 3) Prerequisite: PHY 570 or equivalent.* Mitra

632 Electronics of Solids II *I and II, 3*
Extension of ELE 631, directed toward the examination of theoretical concepts fundamental to solid state electronics. Topics oriented toward current research programs and selected from areas such as quantum electronics, transport properties in strong electric and magnetic fields, and superconductivity. *(Lec. 3) Prerequisite: ELE 631 or equivalent.* Mitra

636 Solid State Electronic Devices *I or II, 3*
Selected topics of current research interest. Materials will be drawn from recent literature on solid state electronic devices. *(Lec. 3) Prerequisite: ELE 536.* Sadasiv

637 Photo-electronics I *I, 3*
Optics, including photometry, radiometry, natural illumination, irradiance, luminance, radiance, temperature. Theory, analysis and specifications of photodetectors, scanners and associated systems. Direct viewing image tubes, their components and electron optics. *(Lec. 3) Prerequisite: ELE 437 or equivalent.* Nudelman and Sadasiv

638 Photo-electronics II *II, 3*
Continuation of ELE 637: theory, analysis, specifications of signal generating (remote) tubes and solid state devices, including transfer characteristics, spectral responses, limiting resolution, modulation transfer function, quantum detective efficiency. Applications to medicine, space, night vision. *(Lec. 3) Prerequisite: ELE 637.* Nudelman and Sadasiv

641 Advanced Engineering Analysis I *I, 3*
Analytical techniques for the solution of problems involving a finite number of degrees of freedom with applications to linear and non-linear systems. *(Lec. 3) Prerequisite: advanced graduate standing and permission of instructor.* Staff

642 Advanced Engineering Analysis II *II, 3*
Continuation of ELE 641. Techniques for the analysis of distributed parameter systems. Applications to diffusion problems and wave propagation. *(Lec. 3) Prerequisite: ELE 605.* Staff

651 Feedback Control Systems I *I, 3*
Analysis of synthesis of complex control systems. Extension of feedback control theory to handle random disturbances, sampled data, and non-linearities. System optimization. *(Lec. 3) Prerequisite: ELE 457 or equivalent and ELE 605.* Lindgren

652 Feedback Control Systems II *II, 3*
Continuation of ELE 651. Topics from current research such as stability of non-linear and time-varying systems, optimal control, self-optimizing systems and learning systems. *(Lec. 3) Prerequisite: ELE 651.* Staff

660 Advanced Topics in System Theory *I or II, 3*
Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. *(Lec. 3) Prerequisite: permission of instructor.* Staff

665 Detection, Estimation and Modulation Theory *I or II, 3*
Advanced treatment of statistical detection, estimation and modulation theory. Applications to communication systems and radar and sonar systems. *(Lec. 3) Prerequisite: ELE 509 or equivalent and competence in probability and statistics.* Staff

672 (or OCE 672) Underwater Acoustics II *II, 3*
Transducers, radiators and receivers, directivity (array structures), equivalent circuits, efficiency; piezoelectricity, magnetostriction, sonar principles, measurements and calibration. *(Lec. 3)* F. Middleton

691, 692 Special Problems *I and II, 1-3 each*
Advanced work under supervision of a staff member. Arranged to suit individual requirements of student. Credits not to exceed a total of 6. *Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ENGLISH (ENG)

433 The Elizabethan Drama *II, 3*

440 Literary Heritage of New England to 1860 *I, 3*

441, 442 American Authors *I and II, 3 each*

445 American Romanticism *II, 3*

446 Modern American Drama *II, 3*

450 The English Renaissance *II, 3*

452 The Seventeenth Century, 1603-1660 *I, 3*

453 The Restoration Period *II, 3*

456 The Augustan Tradition in England *I, 3*

457 The Age of Johnson *II, 3*

461 The Classical Epic *I, 3*

462 The Medieval and Modern Epic *II, 3*

465 Greek and Roman Drama *I, 3*

470 Chaucer *I, 3*

471 The Poetry of Edmund Spenser *I, 3*

472, 473 Shakespeare *I and II, 3 each*

474 Milton *II, 3*

475 Major English Authors of the Eighteenth Century *I or II, 3*

476 Browning *II, 3*

480 The Romantic Movement, 1798-1832 *I, 3*

482, 483 English Literature: 1832-1900 *I and II, 3 each*

484 Modern British Literature *II, 3*

511 Literary Research Methods *I and II, 3*
Problems and applications of the methods of literary research. Directed use of the research library. Usually required of all graduate students in the first year who have not had a similar course elsewhere. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Staff

530 History of the English Language *I, 3*
Historical study of development of English syntax, sounds, vocabulary and usage. *(Lec. 3) Prerequisite: graduate standing or permission of the instructor.* Titus

531 History of Critical Theory *I, 3*
Important critical theories from Aristotle to the twentieth century. Emphasis upon orientation of theories to various aspects of the literary situation. Some study of modern attitudes toward earlier critics. Open to graduate students and senior English majors. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Murphy

532 Modern Literary Criticism *II, 3*
Dominant modes and schools of criticism exemplified by T. S. Eliot, T. E. Hulme, I. A. Richards, Edmund Wilson, John Crowe Ransom, and other important critics. Pertinent related literary works. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1972-73.* Hoffmann and Goldman

541, 542 Studies in American Literature to 1865 *I and II, 3 each*
Selective literary and cultural issues for discussion and research. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. Fall, 1971: Early New England Literature,* Potter. *Fall, 1972: Early Southern Literature,* Tutt. *Spring, 1973: Early American Gothic,* Tutt

543, 544 Studies in American Literature, 1865 to the Present *I and II, 3 each*
Selective literary and cultural issues for discussion and research. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. Fall, 1971: The Twenties,* Hoffmann. *Spring, 1972: Short Story in the Twenties,* Gullason. *Fall, 1972: The Thirties,* Hoffmann. *Spring, 1973: Forms of Modern Tragedy,* Gullason

545 Problems in American Realism and Naturalism *I, 3*
Readings, discussions, and papers on stylistic, thematic, and philosophic issues relating to literary artists like Howells, James, Crane, Dreiser, Hemingway, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Gullason

550 Middle English Literature *II, 3*
Medieval English writing given literary rather than linguistic study. Chaucer's *Troilus and Criseyde* and works by Malory, the *Pearl*-poet, Gower, The Wakefield Master and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* MacLaine

551 The Metaphysical Poets *I, 3*
Intensive analysis and interpretation of poetry of Donne, Herbert, Vaughan, Crashaw, and Marvell. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1971-72.* Sorlien

552 Studies in the English Romantic Period *II, 3*
Intensive study in some particular aspect of British Romantic Movement. The focus will vary, to include specialized areas such as genre concepts, prose, poetry, and major writers. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Petrie and Tutt

553 Studies in Victorian Literature *I or II, 3*
Specific literary themes, genres, significant literary-historical developments, or particular writers. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Goldman and Seigel

555 Modern British Novel *I, 3*
Important British novelists of twentieth century with emphasis on major trends in ideas and techniques. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Hoffmann

561 Modern European Novel *II, 3*
Major developments in European novel during twentieth century. Special attention to Proust, Mann, Kafka, Moravia, Silone, Lagerkvist, Malraux and Camus. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Gullason

564 Modern Poets *I or II, 3*
In-depth study of one or two major modern British or American poets such as Yeats, Eliot, Pound, Frost,

Stevens, Williams, Auden, Thomas, Crane, Lowell, and others; or of a school or small group of poets such as The Imagists or Objectivists, the Auden-MacNeice-Spender group, The Fugitive Poets, etc. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Goldman

570 Anglo-Irish Writers *II, 3*
The Celtic Renaissance as a literary movement, its importance and influence. AE, Lady Gregory, Joyce, O'Casey, O'Flaherty, Stephens, Synge, Yeats, and others. *(Lec. 3) Prerequisite: graduate standing or permission of instructor.* Murphy

573 Problems in Shakespeare *II, 3*
Primarily a discussion course, concentrating on plays and characters that offer most interesting problems for student analysis. Solutions by leading critics are examined. *(Lec. 3) Prerequisite: permission of instructor.* Smith

574 The Scots' Poetic Tradition through Robert Burns *I, 3*
Intensive study of the poetry of Robert Burns, Fergusson, Ramsay, and others who sparked the Scottish revival. *(Lec. 3) Prerequisite: graduate standing or permission of instructor. In alternate years, next offered 1972-73.* MacLaine

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

630 Old English *I, 3*
Introduction to the language and literature. *(Lec. 3)* Staff

631 Advanced Old English *II, 3*
Advanced readings in Old English literature. *(Lec. 3) Prerequisite: ENG 630.* Malina

Courses 640 through 661 are lectures, discussions, extensive readings, individual research, and a substantial research paper. (Lec. 3) Prerequisite: permission of department.

640, 641 Seminar in American Literature before 1900 *I and II, 3 each*
Fall, 1971: Emerson-Thoreau, Marshall. *Spring, 1973: Crane,* Gullason

642, 643 Seminar in Modern Literature (American) *I and II, 3 each*
Fall, 1971: Hemingway, Gullason. *Fall, 1972: Steinbeck,* Gullason

650, 651 Seminar in English Literature of the Middle Ages *I and II, 3 each*
Fall, 1971: Troilus and Criseyde, MacLaine. *Spring, 1972: Fourteenth Century Poetry,* Mensel. *Spring, 1973: Medieval Romance,* Malina

652, 653 Seminar in English Literature of the Sixteenth Century *I and II, 3 each*
Spring, 1972: Marlowe and Jonson, Smith. *Fall, 1972: Renaissance Theories of Man and Literature,* Murphy

654, 655 Seminar in English Literature of the Seventeenth Century *I and II, 3 each*
Fall, 1971: Religious Verse, Jacobs. *Spring, 1972: Pepys and Bunyan,* Sorlien. *Fall, 1972: Dryden,* Sorlien. *Spring, 1973: Restoration Drama,* Kunz

656, 657 Seminar in English Literature of the Eighteenth Century *I and II, 3 each*
Fall, 1971: Eighteenth Century Novel, Joel. *Spring, 1972: Swift,* Reaves. *Fall, 1972: Burns,* MacLaine. *Spring, 1973: Sterne,* Joel

658, 659 Seminar in English Literature of the Nineteenth Century *I and II, 3 each*
Spring, 1972: Coleridge and Arnold, Goldman. *Fall, 1972: Mid-Victorianism,* Seigel

660, 661 Seminar in Modern Literature (English) *I and II, 3 each*
Fall, 1971: Modern British Satirists, McCabe. *Spring, 1972: The Series Novel,* Hoffmann. *Fall, 1972: Images of Reality in Modern Fiction,* Goldman. *Spring, 1973: Bloomsbury Group,* Goldman

691, 692 Special Problems *I and II, 3 each*
Advanced study of an approved topic, under the supervision of a member of the staff. *(Lec. 3) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

EXPERIMENTAL STATISTICS (EST)

411 Statistical Methods in Research I *I, 3*

412 Statistical Methods in Research II *II, 3*

500 Nonparametric Statistical Methods *II, 3*
Inference problems arising when sampling from populations that are not assumed to have a particular functional form. Topics include: rank and sign tests, permutation tests and randomization, estimation, and comparison with parametric procedures. Examples illustrating the applications of nonparametric techniques. *(Lec. 3) Prerequisite: EST 411 and MTH 451, or permission of instructor. In alternate years, next offered 1972-73.* Lawing and Hanumara

511 Linear Statistical Models *I, 3*
Review of mathematical and statistical concepts. The multivariate normal distribution. Distribution of quadratic forms. Power of the F-test. The basic linear models: the general linear hypothesis, regression mod-

els, experimental design models, variance component models, mixed models. *(Lec. 3) Prerequisite: MTH 215 and EST 412 or MTH 452. In alternate years, next offered 1971-72.* Carney

520 Fundamentals of Sampling and Applications *II, 3*
Simple random sampling; properties of estimates, estimation of standard errors, confidence limits. Estimation of sample size; stratified random sampling; optimum allocation, effects of errors, and quota sampling. Regression estimates; systematic and sequential sampling. *(Lec. 3) Prerequisite: EST 411. In alternate years, next offered 1971-72.* Carney and Hanumara

532 (or ASC 532) Experimental Design *II, 3*
Application of statistical methods to biological research and experimentation. Discussion of experimental situations for which various designs are most suitable. *(Lec. 3) Prerequisite: EST 411.* L. T. Smith

541 Multivariate Statistical Methods *I, 3*
Review of mathematical concepts in matrix analysis. Multivariate normal distribution. Tests of hypotheses on means, Hotelling's T^2, discriminant functions. Multivariate regression analysis. Canonical correlations. Principal components. Factor analysis. *(Lec. 3) Prerequisite: EST 412 or PSY 510. In alternate years, next offered 1972-73.* Hanumara and Hemmerle

576 Econometrics I
See Resource Economics 576.

577 Econometrics II
See Resource Economics 577.

591, 592 Problems in Experimental Statistics *I and II, 1-3 each*
Advanced work in experimental statistics. Study of recent developments in data analysis. Courses will be conducted as seminars or as supervised individual topics. *(Lec. 3) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

610 Factor Analysis
See Psychology 610.

635 Response Surfaces and Evolutionary Operations
See Industrial Engineering 635.

FINANCE (FIN)

410 Capital Markets *I and II, 3*

415 Working Capital Management *I, 3*

416 Long-term Investment and Financing *II, 3*

433 Bank Financial Management *I, 3*

440 Problems in Security Investments *II, 3*

452 International Financial Management *II, 3*

491, 492 Special Problems *I and II, 3 each*

641 Financial Management *I and II, 3*
Problems and decisions as to the management of business funds as viewed by the chief financial officer. Case method used. *(Lec. 3)* Staff

648, 649 Seminar in Finance *I and II, 3 each*
Independent research conducted along lines of a theme established by the instructor; individual topics based on reading and research interests of the students; each student to present two papers during the course of each semester. *(Lec. 3)* Staff

940 Principles and Practices of Business Finance and Their Application in Business *I and II, 3*
Uses of financial instruments, problems of capital financing, financial expansion and reorganization, operations of specialized financial institutions. *(Lec. 3) Graduate credit for matriculated MBA students only.* Staff

FOOD AND NUTRITIONAL SCIENCE (FNS)

401, 402 Special Problems *I and II, 2-4 each*

438 Experimental Food Science *II, 3*

441 Advanced Human Nutrition *I, 3*

444 Diet Therapy *II, 3*

445 Readings in Nutrition *II, 2*

502 Advanced Experimental Foods *II, 3*
Application of the principles of food science and technology in the development of food products, considering effective methods of preparation, processing and preservation, and the control and evaluation of food product quality. *(Lab. 6) Prerequisite: permission of department.* Staff

503 Nutrition Research Methods *I, 3*
Comprehensive study of literature. Practice in techniques and methods as applied to animal and human nutrition research. *(Lec. 1, Lab. 4)* Staff

504 Food Science and Nutrition Seminar *II, 3*
Studies and discussions of recent research. Presentation of papers on selected topics from basic and applied food science and nutrition. *(Lec. 3)* Staff

505, 506 Marine Foods Seminar *I and II, 1 each*
Study of current problems of marine foods such as those concerned with the resource, supply, health

safety, nutritive value, preservation and consumer acceptability. Participation by students, faculty, and visiting lecturers. *(Lec. 1)* Staff

531 Teaching of Nutrition
See Education 531.

591, 592 Special Research Problems *I and II, 2-4 each*
Advanced work under supervision of staff member. Arranged to suit individual requirements of students. *Prerequisite: permission of department. For graduate students only.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOOD AND RESOURCE CHEMISTRY (FRC)

411 Soil Chemistry *I, 3*

412 Soil Biochemistry *II, 3*

421 Pesticide Chemistry *I, 3*

431 Biochemistry of Foods *I, 3*

432 Biochemistry of Food Processing *II, 3*

452 Plant Biochemistry *II, 3*

491, 492 Special Projects *I and II, 3 each*

501, 502 Seminar *I and II, 1 each*
Preparation and presentation of papers on subjects in selected areas relating to Food and Resource Chemistry. Staff

526 (or MCH 526) Lipid Chemistry *II, 3*
Advanced course in the chemistry of biologically important lipids such as the fatty acids, neutral glycerides, phospholipids, steroids, and the chemistry and biochemistry of the carotenoids. *(Lec. 3) Prerequisite: BCH 581.* Olney, J. G. Quinn, Simpson, and Turcotte

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

691, 692 Research in Food and Resource Chemistry *I and II, 3 each*
Assigned research on an advanced level. Student is required to outline problem, conduct the necessary literature survey and experimental work, and to present his observations and conclusions in a report. Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

FOOD SERVICES (FDS)

481, 482 Special Problems *I and II, 2-4 each*

FOREST AND WILDLIFE MANAGEMENT (FOR)

401 Forest Influences *I, 3*

402 Wildlife Populations *II, 3*

491, 492 Special Projects *I and II, 1-3 each*

FRENCH (FRN)

402 French Phonetics *II, 3*

431, 432 French Literature of the Seventeenth Century *I and II, 3 each*

441, 442 French Literature of the Eighteenth Century *I and II, 3 each*

451 Romanticism *I, 3*

452 Realism and Symbolism *II, 3*

461 Drama of the Twentieth Century *I, 3*

462 Poetry of the Twentieth Century *II, 3*

463 Twentieth-Century Prose through 1950 *I, 3*

464 Twentieth-Century Prose since 1950 *II, 3*

472 Black and Arab French Theater *II, 3*

497, 498 Directed Study *I and II, 3 each*

501 Advanced Composition *I, 3*
Primarily a course in stylistics designed to prepare undergraduate and graduate majors to write expository French prose. *(Lec. 3) Prerequisite: graduate status or permission of instructor. Required of all candidates for the M.A. degree in French. Should be taken in the first semester of the candidate's work.* Porter

502 Stylistics *II, 3*
Emphasis on acquisition of ability to write at length in an acceptable literary style. Each student will be expected to prepare a study of monograph length on an appropriate subject. *(Lec. 3) Prerequisite: FRN 501 or equivalent.* Porter

503, 504 History of the French Language
I and II, 3 each
Linguistic development of French from the *Serments de Strasbourg* to the end of the Middle Ages. Particular attention to sound and form changes. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

511, 512 French Literature of the Middle Ages
I and II, 3 each
Intensive study of French literature in the medieval period. Reading of selected texts and discussion of the literary values of Old French. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

513 Special Problems in Old French Literature *I, 3*
Detailed study of an individual author or of a particular subject in Old French literature. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Porter

521, 522 French Literature of the Sixteenth Century
I and II, 3 each
Special attention to principal literary movements of the century as illustrated by leading writers of the period. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Benson

531 The Tragic Theater of the Seventeenth Century
I, 3
French tragic theater in the seventeenth century, with particular attention to the works and influence of Corneille and Racine. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Morello

532 The Comic Theater of the Seventeenth Century
II, 3
French comic theater of the seventeenth century, with particular attention to the works and influence of Molière. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Morello

541 The Age of Enlightenment *II, 3*
Intellectual trends in seventeenth-century French literature as it relates to the important eighteenth century philosophical production of Montesquieu, Voltaire, Buffon, Diderot and others. *(Lec. 3) Prerequisite: graduate status or permission of instructor.*
Rothschild

542 The Theater of the Eighteenth Century *I, 3*
Theater of the eighteenth century, with emphasis on the dramatic works of Regnard, LeSage, Marivaux, Voltaire and Beaumarchais. *(Lec. 3) Prerequisite: graduate status or permission of instructor.*
Rothschild

543 The Novel of the Seventeenth and Eighteenth Centuries *I, 3*
Evolution of the French novel, with emphasis on writers such as D'Urfé, Scarron, Mme. de Lafayette, LeSage, Marivaux, Prévost, Voltaire and Diderot. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Rothschild

551 The Romantic Movement *I, 3*
Detailed study of the chief proponents of the movement, particularly Chateaubriand, Mme. de Staël, Constant, Lamartine, Hugo, Vigny, Musset, Sand *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.* Toloudis

552 Realism and Naturalism *I, 3*
French Realism and Naturalism as illustrated in Balzac, Flaubert, Zola, de Maupassant, the Goncourt *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.* J. Hyland

553 The Symbolist Movement *I, 3*
Intensive study of poetry of Baudelaire, Verlaine, Rimbaud, Mallarmé and of their sources and influence. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Waters

561 Contemporary French Theater through 1950
I and II, 3
Survey of important dramatists and *metteurs en scène* from Symbolism and Realism through 1950. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Toloudis

562 French Theater since 1950 *II, 3*
Emphasis on recent developments such as the theater of the absurd and social theater. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Waters

563 The Novel of the Twentieth Century *I, 3*
Intensive study of major novelists with emphasis on trends in philosophies and in techniques as illustrated by such authors as Gide, Mauriac, Malraux, Saint-Exupéry, Sartre, Camus, *et al. (Lec. 3) Prerequisite: graduate status or permission of instructor.*
Toloudis

591 Proust and Claudel *II, 3*
Analysis and interpretation of the imaginative writings of Proust and Claudel. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Waters

594 Graduate Seminar *I and II, 3*
Group and/or individual investigation of special problems in French literature. Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

901, 902 Graduate Reading Course in French
I and II, 0
Two-semester course prepares the graduate student in other fields to use French to further research in his major field. Attention is given primarily to acquiring a reading knowledge with little emphasis on the spoken language. Assumes no prior knowledge of French. Staff

GENERAL BUSINESS ADMINISTRATION (GBA)

410 Business Policy *II, 3*

655 International Business Administration *I and II, 3*
Problems and policies of international business enterprise; economic, legal, political, social and cultural aspects. *(Lec. 3) Prerequisite: permission of department.* Staff

671 Methods of Business Research *I and II, 3*
Toward an understanding of the role, spirit, and methodology of business research. Assigned research projects. *(Lec. 3) Prerequisite: permission of department.* Poulsen

681 Administrative Policy and Decision-making *I and II, 3*
Review of the functional areas of marketing, production, finance, economics, accounting, quantitative methods, organization theory, interpersonal relationships, control and motivation systems, and communications. Includes the MBA written comprehensive examination according to Graduate School requirements. *(Lec. 3) Prerequisite: permission of MBA director.* Staff

GENETICS (GEN)

470 (or ASC 470) Population Genetics *II, 3*

579 Advanced Genetics Seminar
See Zoology 579.

683 (or OCG 683) Quantitative Genetics I *I, 3*
Quantitative approach to population genetic phenomena. Derivation of theoretical genetic formulae. Expected genetic change and its constituent genetic parameters. *(Lec. 3) Prerequisite: GEN 352, MTH 141, or permission of instructor.* Staff

684 (or OCG 684) Quantitative Genetics II *II, 3*
Interpretation and application of theoretical genetic formulae and parameters. *(Lec. 3) Prerequisite: GEN 683 or permission of instructor.* Staff

GEOGRAPHY (GEG)

403 Meteorology and Climatology I *I, 3*

404 Meteorology and Climatology II *II, 3*

407 Selected Topics in Meteorology *II, 2*

411 Urban Geography *I, 3*

412 Seminar in Urban Geography *I and II, 3*

421 Introductory Cartography *I and II, 3*

422 Advanced Cartography *II, 3*

432 Seminar in Political Geography *II, 3*

441 Geography of Europe *I, 3*

442 Geography of the Soviet Union *I, 3*

443 Geography of the United States and Canada *II, 3*

444 Geography of the Middle East and the Indian Subcontinent *II, 3*

445 Geography of Modernization in Africa *II, 3*

446 Geography of the Polar Regions *II, 3*

451 Land Utilization *I, 3*

463 Geography of World Resources *II, 3*

491, 492 Special Problems in Geography *I and II, 3 each*

502 Research Methods in Geography *I, 3*
Fundamentals of geographic research, including techniques of field observation and interpretation, and the introduction to the use of the Computer Laboratory and computer package program. *(Lec. 3) Prerequisite: GEG 491 or permission of department.* Staff

526 Plant Geography
See Botany 526.

543 Geography of Megalopolis *I, 3*
A geographical analysis of the northeastern seaboard of the United States in terms of its physical and economic foundations, its distinctiveness as a region, and the key role the analysis of Megalopolis plays in understanding incipient major conurbations in the United States and the world. *(Lec. 3) Prerequisite: GEG 443 or 544 or permission of department. In alternate years, next offered 1971-72.* Staff

544 Historical Geography of the United States *I, 3*
Selected regional analysis of the United States, stressing patterns of settlement, routes of migration, frontier advance, and resource development from the colonial period into the twentieth century. *(Lec. 3) Prerequisite: GEG 103, 443, or permission of department.* Staff

545 Geography of the North Atlantic Basin *II, 3*
Description and analysis of the North Atlantic Ocean and its borderlands, including northeastern North America and the western littoral of Europe. Emphasis on orientation to, and use of, the marine environment, and on the role of the North Atlantic both as a uniting and divisive force in the western community. *(Lec. 3) Prerequisite: GEG 131 or permission of department.* Alexander

571 Marine Geography *I, 3*
The marine region as a unique complex of physical and cultural elements. The purpose is to analyze functional relationships within the region and to assess forms of regional organization and control. *(Lec. 3) Prerequisite: permission of department.* Alexander

591, 592 Directed Study or Research *I and II, 3 each*
Covers areas of special research interests of graduate students. *(Lec. 3) Prerequisite: permission of department.* Staff

595 Problems of Modernization in Developing Nations
See Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

GEOLOGY (GEL)

410 Geomorphology *I, 3*

420 Mineralogy *I, 3*

421 Optical Mineralogy *II, 3*

425 Principles of Geochemistry *I, 3*

430 Petrology *II, 3*

440 Introduction to Paleontology *I, 3*

450 Introduction to Stratigraphy and Sedimentation *II, 3*

465 Introduction to Geophysics *II, 3*

470 Structural Geology *II, 3*

490 Senior Thesis *I and II, 3*

510 Coastal Geomorphology *II, 3*
Principles of coastal development and interpretation in relation to endogenetic and exogenetic shore processes including beach formation and erosion. Former beaches on emerged coastal plains and submerged continental shelves are related to experimental model studies and applied field studies. *(Lec. 2, Lab. 3) Prerequisite: GEL 410, or permission of instructor. Offered in spring of odd calendar years.* Fisher

526 Igneous and Metamorphic Geochemistry *II, 3*
Applications of elementary thermodynamics to geologic problems including phase equilibria and igneous and metamorphic reactions. Incorporates the classical approach and a survey of the current literature in the area of geochemical petrology. *(Lec. 3) Prerequisite: GEL 425, MTH 243. Offered in spring of odd calendar years.* Hermes

530 Igneous Petrology *I, 3*
Tectonic and chemical bases for igneous phenomena stressing the association concept of igneous activity. Evaluation of the criteria used in petrogenetic interpretations. *(Lec. 2, Lab. 3) Prerequisite: GEL 430 and CHM 331, or permission of instructor. Offered in fall of odd calendar years.* Cain

531 Metamorphic Petrology *II, 3*
Facies concept and other methods of interpreting metamorphic mineral assemblages. Chemical and fabric changes during metamorphism, including principles of structural petrology. *(Lec. 2, Lab. 3) Prerequisite: GEL 430 and CHM 331, or permission of instructor. Offered in spring of even calendar years.* Cain

541 Animal Micropaleontology *II, 3*
Concentrated study of animal microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. *(Lec. 2, Lab. 3) Prerequisite: GEL 440 or permission of instructor. Offered in spring of even calendar years.* Tynan

542 Plant Micropaleontology *I, 3*
Concentrated study of plant microfossils with primary emphasis on taxonomy, morphology, ecology, and stratigraphic occurrence. *(Lec. 2, Lab. 3) Prerequisite: GEL 541 and BOT 111, or permission of instructor. Offered in fall of even calendar years.* Tynan

550 Sedimentation *I, 3*
Study of sedimentary processes. Topics include the origin of the original rock, transport of clastics and dissolved materials, deposition of sediments, changes in the sediments before complete lithification, and lithification. Laboratory: comprises methods and techniques to obtain data for solution of sedimentary problems. *(Lec. 2, Lab. 3) Prerequisite: GEL 440, 450, or permission of instructor. Offered in fall of even calendar years.* Hampton

551 Sedimentary Petrology *II, 3*
Characteristics of sediments and sedimentary rocks as a function of the environments of source, transportation, deposition, and diagenesis. *(Lec. 2, Lab. 3) Prerequisite: GEL 550 or permission of instructor. Offered in spring of odd calendar years.*

555 Stratigraphy *II, 3*
Study of the principles and methods used to analyze and interpret areal and time relationships of stratified rocks and the history of life contained in the rocks. *(Lec. 2, Lab. 3) Prerequisite: GEL 450 or permission of instructor. Offered in spring of odd calendar years.* Tynan

561 Evaluation of Geologic Data *I, 3*
Discussion of the quantification of geologic data including methods and limitations of quantification. Development and evaluation of concepts of sampling, accuracy, precision, and hypothesis and model formulation as applied to geology. Sources, types, and de-

grees of error in sampling, measuring and presenting geologic data. *(Lec. 3) Prerequisite: two 100-level courses in geology and BST 501 or equivalent, or permission of instructor. Offered in fall of even calendar years.* Cain

581 (or OCE 581) Coastal Engineering Geology *II, 3*
Discussion of the interaction of geological factors and coastal structures. Shore materials, energy-material relationships, and the interference of man-made structures with the natural regimen emphasized. *(Lec. 3) Prerequisite: GEL 302 or 410, or OCE 540, or permission of instructor. Offered in spring of even calendar years.* Fisher

585 Geohydrology *I, 3*
Introduction to ground-water hydrology and drainage basin analysis and their relation to geomorphology, glacial geology and sedimentology. Laboratory work in analog models and analysis of water resources in various geologic environments from geologic maps and aerial photography. Field studies in geophysical methods of investigation. *(Lec. 2, Lab. 2) Prerequisite: GEL 302 or 410 or 450 or permission of department. Offered in fall of odd calendar years.* Fisher

590 Special Problems *I and II, 1-3*
Advanced work under the supervision of a member of the staff arranged to suit the individual requirements of the student. *(Lec. and/or Lab. according to the nature of the problem.) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: For other related courses see PHY 522 and OCG 540, 630, 631, 643, 644, 645, 647.

GERMAN (GER)

409 History of the German Language *I, 3*

431 German Literature from 800 to 1700 *II, 3*

441, 442 German Literature of the Eighteenth Century *I and II, 3 each*

451, 452 German Literature of the Nineteenth Century *I and II, 3 each*

481 The German Lyric *I, 3*

482 German Drama *I, 3*

483 German Narrative *II, 3*

497, 498 Directed Study *I and II, 3 each*

901, 902 Graduate Reading Courses in German *I and II, 0*
Two-semester course prepares the graduate student in other fields to use German to further research in his major field. Attention is given primarily to acquiring a reading knowledge with little emphasis on the spoken language. Assumes no prior knowledge of German. Staff

HISTORY (HIS)

405 Western Europe in the High Middle Ages *I or II, 3*

406 The Renaissance *I, 3*

407 The Reformation *II, 3*

408 History of Europe, 1648-1789 *I, 3*

409 The French Revolution and Napoleon *II, 3*

410 History of Europe, 1815-1914 *I, 3*

411 History of Europe since 1914 *II, 3*

414 Seventeenth- and Eighteenth-Century European Cultural History *I, 3*

415 Nineteenth- and Twentieth-Century European Cultural History *II, 3*

416 History of Science to 1700 *I, 3*

417 History of Science since 1700 *II, 3*

418 Diplomatic History of Europe since 1815 *I, 3*

420 Constitutional History of England *I, 3*

421 Tudor and Stuart England, 1485-1714 *II, 3*

422 England in the Eighteenth and Nineteenth Centuries *I, 3*

423 Twentieth-Century Britain *II, 3*

426 German History, 1640-1871 *I, 3*

427 German History since 1871 *II, 3*

430 History of France since 1815 *II, 3*

432 History of Russia to 1917 *I, 3*

433 History of the Soviet Union *II, 3*

435 American Colonial History to 1763 *I, 3*

436 The American Revolution and Confederation, 1763-1789 *II, 3*

437 The United States during the Early National Period, 1789-1850 *I, 3*

438 Civil War and Reconstruction *II, 3*

439 Emergence of Industrial America, 1877-1917 *I, 3*

440 United States History from 1917 to 1945 *I or II, 3*

441 United States History since 1945 *I or II, 3*

442 Social and Intellectual History of the United States to 1865 *I, 3*

443 Social and Intellectual History of the United States, 1865 to the Present *II, 3*

445 History of the Negro Peoples *II, 3*

448 American Social Reform *I or II, 3*

450 Constitutional History of the United States *II, 3*

452 Diplomatic History of the United States *I, 3*

462 History of Rhode Island *II, 3*

471 History of the Far East: Classical Period *I, 3*

472 History of the Far East: Modern Period *II, 3*

473 History of Modern China *II, 3*

474 History of Modern Japan *I, 3*

476 Southwest Asia and North Africa to 1683 *I, 3*

477 Southwest Asia and North Africa since 1683 *II, 3*

479 Imperialism and Its Impact upon Colonized Peoples *I, 3*

481 History of Colonial Latin America *I, 3*

482 History of Modern Latin America *II, 3*

483 History of Modern Mexico *I or II, 3*

488 History of Sub-Saharan Africa *I, 3*

501 Colloquium in European History *I or II, 3*
Intensive study of major interpretative works in European history. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

515 Seminar in Twentieth-Century Diplomacy *II, 3*
Research in the history of international relations since 1900. *(Lec. 3) Prerequisite: HIS 410 or 411 or permission of department.* Thomas

516 Seminar in the History of Science *I or II, 3*
Seminar devoted to exploration of some historical aspects of scientific development. The major topics will change from semester to semester. *(Lec. 3)* Briggs

521, 522 Readings and Research in European History *I and II, 3 each*
Intensive study of selected topics in European history. With permission of the department, this course may be taken twice for credit. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

535 Colloquium in American History *I or II, 3*
Intensive study of major interpretative works in American history. *(Lec. 3) Prerequisite: graduate or senior standing, permission of department.* Staff

540 Seminar in American Colonial History: The Seventeenth and Eighteenth Centuries *I or II, 3*
Intensive research on selected topics in the Colonial period of American history. *(Lec. 3) Prerequisite: permission of department.* Staff

541 Seminar in Nineteenth-Century American History *I and II, 3*
Intensive research on selected topics in the broad period between adoption of the Constitution and World War I. *(Lec. 3) Prerequisite: permission of department.* Staff

542 Seminar in Twentieth-Century United States History *I and II, 3*
Intensive research on selected topics in United States history since 1900. *(Lec. 3) Prerequisite: permission of department.* Staff

543 Seminar in the History of the United States, Foreign Relations *II, 3*
Research in the history of U.S. foreign relations since 1775. All aspects of foreign relations, including both internal and external factors and historiographical problems will be considered. *(Lec. 3) Prerequisite: HIS 452 or permission of department.* Staff

550 Seminar in Black Nationalism and the International Race Problem *I or II, 3*
Examination of the historical roots of black nationalism in the United States and the international implications of racial conflicts in selected areas of the world. *(Lec. 3) Prerequisite: permission of instructor.* Weisbord

560 Research in Local History *II, 3*
Directed research in secondary and primary materials on topics of interest to the individual. *(Lec. 3) Prerequisite: HIS 141 and 142.* Metz

580 Colloquium in Latin-American History *I or II, 3*
Intensive study of major interpretative works in Latin American history. *(Lec. 3)* Bryan

591 Directed Study or Research *I and II, 3*
Directed readings, research, or study designed to meet

the particular needs of individuals or small groups of graduate students. Staff

593 Seminar in Historical Studies *I and II, 3*
Advanced study in the major literature of American or European history. Emphasis placed upon problems of historiography and historical criticism. *(Lec. 3) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

HOME MANAGEMENT (HMG)

401 Home Management Problems of Deprived Families *II, 3*

470 Special Problems in Home Management *I and II, 2-4*

570 Special Problems in Home Management *I, 3*
Advanced study to be selected from areas of home management theory and its application, work simplification, family economics and equipment. *(Lab. TBA)* Staff

575 Presentation of Home Management Principles *II, 3*
Special problems in presenting principles of home management at the secondary level, the college level, and in adult education. *(Lec. 3)* Staff

INDUSTRIAL ENGINEERING (IDE)

404 Engineering Economy *I, 3*

411 Engineering Statistics I *I, 3*

412 Engineering Statistics II *II, 3*

422 Production Facilities Design *II, 3*

430 Design and Analysis of Compensation Systems *II, 3*

432 Operations Research I *I, 3*

433 Operations Research II *II, 3*

440 Materials Processing and Metrology I *II, 3*

491, 492 Special Problems *I and II, 1-6 each*

500 Network Application in Industrial Engineering *II, 3*
Industrial system problems that can be formulated in terms of flows in networks. Critical path scheduling, transportation problems, allocation, sequencing, and line balancing are some of the topics to be considered. *(Lec. 3) Prerequisite: IDE 432 and permission of instructor. In alternate years, next offered 1972-73.* Staff

510 Human Factors *II, 3*
Analytic relationships between man and his working environment. The design of equipment, facilities and environmental controls to meet the capabilities and limitations of the human being. *(Lec. 3) Prerequisite: permission of instructor.* Staff

513 Statistical Quality Control *I, 3*
Topics in statistical quality control systems. Single, multiple, and sequential sampling. Design and analysis of a wide variety of statistical control systems used in conjunction with discrete and continuous data, for several kinds of data emission. *(Lec. 3) Prerequisite: IDE 412 or equivalent.* Nichols

517 Applied Control Theory in Industrial Engineering *I, 3*
Complex control mechanisms will be studied and applied to production and manufacturing operation. Automatic control systems for production and manufacturing will be designed and analyzed. *(Lec. 3) Prerequisite: IDE 404, MTH 244 and permission of instructor.* Stanislao

520 Material Handling *I, 3*
Development of principles for the engineering design and evaluation of equipment to move industrial materials in and between processes, including the chemical and physical characteristics of the material to be handled, rates of material flow, queuing and economics. *(Lec. 3) Prerequisite: MCE 263, CVE 220, IDE 404.* Staff

525 Simulation
See Computer Science 525.

533 (633) Advanced Statistical Methods for Research and Industry *I, 3*
Estimation and testing; regression and correlation; analysis of variance and related topics. Applications in industrial operations and engineering research. *(Lec. 3) Prerequisite: IDE 412 or equivalent.* Staff

535 Industrial Reliability Engineering *II, 3*
Theories of reliability applicable to the design and operations of manufacturing processes and product quality assurance control systems. Quantitative analyses of economic specifications, performance levels, maintenance levels, and redundancy systems. *(Lec. 3) Prerequisite: permission of instructor.* Staff

540 Production Control and Inventory Systems *I, 3*
Theory and practice of industrial production control and inventory systems. A broad spectrum of mathematical models for static, dynamic, perpetual, and periodic inventory systems as they affect and relate to production. *(Lec. 3) Prerequisite: permission of instructor.* Staff

541 Materials Processing and Metrology II *I, 3*
Continuation of IDE 440. Engineering analyses in the processing of materials. A detailed study of dynamic coupling, tool-workpiece interaction, energy and thermal analysis; mechanics of material removal and displacements, advanced topics in mechanical electrical systems for processing of materials. *(Lec. 3) Prerequisite: IDE 440 or permission of instructor.* Stanislao

550, 551 Advanced Topics in Probabilistic Operations Research I and II *I and II, 3 each*
Concepts of simple random processes and their application in the analysis of industrial problems. Random walk, branching processes, recurrent events, discrete and continuous Markov chains, birth and death models and their application to inventory, replacement, reliability, and waiting line problems. *(Lec. 3) Prerequisite: IDE 411, MTH 215, or equivalent.* Staff

555 Engineering Applications of Mathematical Programming I *I, 3*
Sensitivity analysis and pricing problems, practical problems in degeneracy and duality, decomposition methods for large-scale systems, applied convex, integer, nonlinear and quadratic programming methods. An introduction to stochastic programming. *(Lec. 3) Prerequisite: IDE 432 and permission of instructor.* Staff

556 Engineering Applications of Mathematical Programming II *II, 3*
Continuation of IDE 555. *(Lec. 3) Prerequisite: IDE 555 and permission of instructor. In alternate years, next offered 1972-73.* Staff

560 Process Engineering *II, 3*
Design and selection of processes, equipment, instrumentation and production sequence for efficient and economic manufacture of products through mathematical analyses of physical and economic principles. *(Lec. 3) Prerequisite: IDE 330, 404.* Stanislao

565 Theory of Scheduling *II, 3*
Sequencing problems, finite sequencing for a single machine, n/m job shop problems with analytical and heuristic procedures, networks applied to scheduling, queuing systems in scheduling, probabilistic scheduling problems. Survey of selected literature. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1971-72.* Staff

591, 592 Special Problems *I and II, 1-6 each*
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to the nature of the problem) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

610 Topics in Applied Queuing Theory *I, 3*
Poisson and Erlang queues, imbedded chains, M/G/1 and G/M/1 queues, and related topics in queuing theory. Analysis of a wide variety of queues with an applications orientation. *(Lec. 3) Prerequisite: IDE 433 or permission of instructor. In alternate years, next offered 1971-72.* Branson

634 Design and Analysis of Industrial Experiments *II, 3*
Further development of topics in analysis of variance. Randomized blocks, Latin squares and related designs, factorial experiments, confounding and fractional replications, and split-plot designs. Design and analyses of engineering experiments. *(Lec. 3) Prerequisite: IDE 633.* Staff

635 (or EST 635) Response Surfaces and Evolutionary Operations *II, 3*
Methods of determining the response surface for multiple factors over a specified range and techniques for seeking an optimum. First and second order response surfaces. Rotatable second order design. Central composite rotatable designs. Multi-variable EVOP programs and other topics in evolutionary operations. *(Lec. 3) Prerequisite: IDE 633 or equivalent.* Lawing

641 Molecular Aspects of Materials Processing
See Chemical Engineering 637.

642 Advanced Topics in the Processing of Materials I *I or II, 3*
Extensive studies of contemporary and classical research in metallic materials processing. Systems study of problems of processing modern materials and the technological achievements in processing. *(Lec. 3) Prerequisite: IDE 541 or permission of instructor. In alternate years, next offered 1971-72.* Stanislao

643 Advanced Topics in the Processing of Materials II *I or II, 3*
Extensive studies of contemporary and classical research in non-metallic materials processing. Systems study of problems of processing modern materials and the technological achievements in processing. *(Lec. 3) Prerequisite: IDE 541 or permission of instructor. In alternate years, next offered 1972-73.* Stanislao

645 Manufacturing Engineering: Design, Analysis, Synthesis *II, 4*
Consideration of production and logistic systems, quantitative models introduced in and applied to congestion problems, industrial planning, behavioral theory, control, scheduling, and other problem areas of the industrial enterprise. *(Lec. 4) Prerequisite: permission of instructor.* Stanislao

657 Geometric and Dynamic Programming *II, 3*
Basic concepts of geometric programming, the duality theorem, approximation and limiting techniques. Nature of dynamic programming, deterministic and stochastic sequential decision problems. Lagrange multipliers in both geometric and dynamic programming. *(Lec. 3) Prerequisite: IDE 555. In alternate years, next offered 1971-72.* Shao

660 Methods of Optimization *II, 3*
Methods of optimization: indirect, direct elimination, climbing. Geometric programming. Problems and other topics in applied optimization. *(Lec. 3) Prerequisite: CSC 500 and permission of instructor. In alternate years, next offered 1971-72.* Staff

691, 692 Advanced Special Problems in Industrial Engineering *I and II, 1-6 each*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problems) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

ITALIAN (ITL)

409, 410 History of the Italian Language *I and II, 3 each*

411, 412 Italian Literature of the Middle Ages *I and II, 3 each*

421, 422 Italian Literature of the Renaissance *I and II, 3 each*

431 Italian Literature of the Seventeenth Century *I, 3*

442 Italian Literature of the Eighteenth Century *II, 3*

451, 452 Italian Literature of the Ninteenth Century *I and II, 3 each*

461, 462 Italian Literature of the Twentieth Century *I and II, 3 each*

481, 482 La Divina Commedia *I and II, 3 each*

497, 498 Directed Study *I and II, 3 each*

JOURNALISM (JOR)

433 Contemporary Press Problems *I, 3*

435 Theory of Communication *I, 3*

438 Governmental and Legal Aspects of Mass Communication *I, 3*

440 Criticism, Opinion and Interpretation in the Mass Media *II, 3*

441 International Communications *I, 3*

442 Independent Study and Projects in Mass Communications *I and II, 1-3*

452 Public Relations Principles and Publications *I, 3*

LATIN (LAT)

497, 498, Directed Study *I and II, 3 each*

LIBRARY SCIENCE (LSC)

501 The Library in Society *I and II, 3*
The library traced from antiquity through its place today as a social agency in the major countries of the world, with attention also to education for and the philosophy and ethics of the profession of librarianship. *(Lec. 3)* Bergen

502 Library Administration *I and II, 3*
Libraries and their governing agencies, scientific management principles, organization and operation of library departments, personnel problems and procedures, budget preparation, statistics, and quarters and planning. *(Lec. 3)* Bohnert or Healey

503 Selection of Library Materials *I and II, 3*
Study of and practice in using the principles involved in the selection of books and nonbook materials for collections of all types of libraries. *(Lec. 3)* Tryon

504 Basic Reference *I and II, 3*
Practical experience in the use of basic reference materials, with readings and discussion of the philosophy and administrative aspects of reference work. *(Lec. 3)* Schneider

505 Cataloging and Classification *I and II, 3*
Descriptive and subject cataloging of books and other library materials with stress on subject headings and cross references, using the Dewey Decimal Classification and introducing conventional procedures and those that employ machines. *(Lec. 3)* Chin

506 Technical Services *I and II, 3*
Principles and policies employed in the acquisition, organization, conservation, and circulation of book and nonbook materials in libraries of various kinds. *(Lec. 3)* Chin

510 History of Books and Printing *I or II, 3*
Western civilization as affected by the book arts and the extension of culture through the printed book, with stress on literary property and censorship as related to printing and libraries. *(Lec. 3)* Tryon

511 Comparative Librarianship *I and II, 3*
The practice of librarianship in selected countries, including the social, economic, and political factors in-

fluencing its development, with consideration of the role of cooperation among international organizations. *(Lec. 3)* Bergen

520 The School Library *I and II, 3*
The school library in relation to the school curriculum, other community library resources, and extracurricular needs of the students. Special problems in the selection of materials, budgets, and standards for the library as a materials center with an active part in the teaching function of the school. *(Lec. 3) Prerequisite: LSC 502.* Salvatore

521 Public Library Service *I or II, 3*
Reading on and discussion of the backgrounds, aims, and problems of the American public library, with particular attention to larger unit systems. *(Lec. 3) Prerequisite: LSC 502.* Healey

522 College and University Library Service *I or II, 3*
Philosophic and practical considerations implicit in the functions, organization, and management of college and university libraries as these differ from other types of libraries. *(Lec. 3) Prerequisite: LSC 502.* Tryon

523 Special Library Service *I or II, 3*
Organization, management, and regular and special procedures as they apply to special libraries, with particular emphasis upon standards and planning for space and equipment. *(Lec. 3) Prerequisite: LSC 502.* Bohnert or Chin

524 Medical Librarianship *II, 3*
The functions and administration of medical libraries, along with the book selection tools, special cataloging methods, and essential reference works and bibliographies thereof. *(Lec. 3) Prerequisite: permission of instructor.* Chin

526 Automation in Libraries *I or II, 3*
The application of technology and systems analysis to the operation of various types of libraries. *(Lec. 3) Prerequisite: permission of instructor.* Healey

527 Seminar in Library Administration *I and II, 3*
Intensive study of selected problems in important areas of library administration by means of discussion, readings, special lectures, and the presentation of papers based on literature surveys or research. *(Lec. 3) Prerequisite: permission of instructor.* Healey

528 Multi-Media and the Library *I and II, 3*
The role of A-V materials in media centers and other types of libraries. *(Lec. 3) Prerequisite: LSC 520.* Salvatore

530 Reading Interests of Children *I or II, 3*
Survey of the development of children's literature, with analysis of current trends in publication, the limited-vocabulary book at beginning and advanced levels, and the significance of illustrations for the reading process. Fiction considered but main emphasis on informational books as recreational reading. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

531 Reading Interests of Adolescents *I or II, 3*
Materials of special interest to high school students in school and public libraries, stressing nonfiction but including fiction for the age group and for adults and the responsibility of the library in the drop-out problem. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

532 Reading Interests of Adults *I or II, 3*
Examination of the range and depth of books as a source of appeal to adults with emphasis on reading, annotations, and discussion to develop critical faculties. *(Lec. 3)* Tryon

533 Children's Library Materials *I and II, 3*
Books and related library materials in the area of creative literature for children: history, bibliography, selection, evaluation, and presentation. *(Lec. 3) Prerequisite: LSC 503.* Salvatore

536 Storytelling *I, 3*
Selection, adaptation, and presentation of stories for children of all ages, including attention to sources of materials, planning the story hour, and training and practice in the art of storytelling. *(Lec. 3)* Staff

540 Library Materials in the Humanities *I and II, 3*
Important library resources in the humanities, including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3) Prerequisite: LSC 504.* Schneider

541 Library Materials in the Social Sciences *I and II, 3*
Important library resources in the social sciences, including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3) Prerequisite: LSC 504.* Bergen or Schneider

542 Library Materials in Science and Technology *I and II, 3*
Important resources in science and technology including the major works, serial publications, and reference and bibliographical materials thereof. *(Lec. 3)* Bohnert or Chin

543 Government Publications *I or II, 3*
Survey of the publishing activities and publications of national, state, and local governments with emphasis on the publications of the United States government. *(Lec. 3) Prerequisite: LSC 504.* Schneider

544 Information Science for Librarians *I or II, 3*
Introduction to information storage and retrieval (analysis, semantics, thesaurus building, and data banks and their implications) as it applies to librarianship. *(Lec. 3)* Bohnert

545 Technical Information Centers *I and II, 3*
New technical information centers which provide publication, consultant, and question-answering services, emphasizing the differences between them and

technical libraries and professional societies. *(Lec. 3) Prerequisite: permission of instructor.* Bohnert

550 Advanced Cataloging *I or II, 3*
Cataloging special materials, corporate author entry theory, and catalog department organization, for prospective catalogers and those interested in the technical processing aspects of librarianship. *(Lec. 3) Prerequisite: LSC 505.* Chin

560 Research in Librarianship *I or II, 3*
Methods of investigating problems in library science and an introduction to and evaluation of the literature of the field. *(Lec. 3) Prerequisite: permission of instructor.* Humeston or Bohnert

591, 592, 593 Independent Work *By Appt., 1-3 each*
Supervised reading or investigation in areas of special interest to students who obtain written approval for such study prior to registration for the semester for which it is proposed. *Prerequisite: 18 hours of library science with a B average.* Staff

LINGUISTICS (LIN)

409, 410 Introduction to the Study of Language *I and II, 3 each*

414 Romance Linguistics *II, 3*

MANAGEMENT SCIENCE (MGS)

457 (MGT 457) Advanced Production Management *I, 3*

458 (MGT 458) Advanced Production Management *II, 3*

476 (MGT 476) Management System Analysis *II, 3*

491, 492 (MGT 491, 492) Special Problems *I and II, 3 each*

681 Operations Management *II, 3*
Problems facing the manager of production and other business processes which are devoted to the creation of capital as well as consumer goods and services are examined and analyzed, employing modern decision-making techniques. *(Lec. 3) Prerequisite: MGS 980 and BST 981.* Vollmann and Zartler

682 (QBA 682) Quantitative Business Analytical Techniques *I and II, 3*
Development and application of the principal mathematical and statistical techniques used in model building and decision-making in the firm under conditions of certainty and uncertainty. *(Lec. 3) Prerequisite: MGS 980 and BST 981.* Gross, Jarrett, Shen and Shih

683 (QBA 683) Business Decision Theory *I, 3*
A statistical analysis of managerial decision-making under uncertainty. Bayesian statistical inference and subjective probability are stressed. Comparisons between Bayesian method and classical statistics are discussed and applications to business problems are emphasized. *(Lec. 3) Prerequisite: BST 981, MGS 980 or equivalent.* Jarrett and Shih

684 (QBA 684) Advanced Programming Methods in Management Decisions *II, 3*
Introduction to nonlinear and dynamic programming. Emphasis on application of modern mathematical optimization techniques in single-stage and multiple-stage management decision problems. Management applications of the Kuhn-Tucker theorem, quadratic programming, geometric programming, convex programming, integer programming, and dynamic programming. *(Lec. 3) Prerequisite: MGS 980 and 682 or equivalent.* Gross and Shih

980 (QBA 980) Quantitative Methods for Business Analysis *I and II, 3*
Mathematical tools useful to managers. Depth coverage given to differential and integral calculus, vectors and matrices. *(Lec. 3) Graduate credit for matriculated MBA students only.* Armstrong, Gross, Shen and Staff

MARINE AFFAIRS (MAF)

650 Seminar in Marine Affairs *II, 6*
Interdisciplinary seminar by representatives of each department offering core courses in the Marine Affairs Program; faculty-student workshops focus on relations among the various marine-oriented disciplines in solving problems associated with the marine environment. Emphasis on integration of information and techniques from food and resource economics, geography, ocean engineering, the oceanographic sciences, and political science. One or more substantial papers required. Staff

MARKETING MANAGEMENT (MMG)

443 Retail Store Management *I, 3*

452 International Marketing *II, 3*

462 Marketing Research *II, 3*

464 Marketing Policy and Problems *II, 3*

474 Advertising Seminar *I, 3*

475 Advertising Campaigns *II, 3*

481, 482 Directed Study *I and II, 3 each*

651 Marketing Management *I and II, 3*
Analysis of marketing problems and determination of

marketing policies in product development, promotion, pricing, channel selection; legal aspects. *(Lec. 3) Prerequisite: MMG 950 or equivalent.* Staff

656 International Marketing Management *I and II, 3*
Marketing policy-making for the multinational firm; organizing for international marketing; its opportunities, pricing, channels, promotion, research. *(Lec. 3) Prerequisite: MMG 651.* Staff

658, 659 Seminar in Marketing *I and II, 3 each*
Preparation and presentation of papers on selected topics in marketing. *(Lec. 3) Prerequisite: MMG 950 and 651.* Staff

950 Marketing Survey *I and II, 3*
Fundamentals of marketing. Broad coverage of the field; its place in the economy. *(Lec. 3) Graduate credit for matriculated MBA students only.* Staff

MATHEMATICS (MTH)

418 Matrix Analysis *II, 3*

425 Topology *I, 3*

441 Introduction to Partial Differential Equations *I, 3*

442 Vector and Tensor Analysis *II, 3*

443 Tensor Analysis and Applications *II, 3*

444 Ordinary Differential Equations *II, 3*

451 Introduction to Probability and Statistics *I, 3*

452 Mathematical Statistics *II, 3*

456 Probability *II, 3*

461 Methods of Applied Mathematics *I, 3*

462 Functions of a Complex Variable *I and II, 3*

472 Introduction to Numerical Analysis *I, 3*

492 (392) Special Problems *I and II, 1-3*

515, 516 Algebra I, II *I and II, 3 each*
Groups, rings, modules, commutative algebra. *(Lec. 3) Prerequisite: MTH 316.* Staff

525 Topology I *I, 3*
Topological spaces, separation properties, connectedness, compactness, uniformities. Function spaces, spaces of continuous functions and complete spaces. *(Lec. 3) Prerequisite: MTH 425 or equivalent.* Staff

526 Topology II *II, 3*
Homotopy. Fiberspaces. Homology and cohomology. Notions of homological algebra. Products. *(Lec. 3) Prerequisite: MTH 525.* Staff

535, 536 Measure Theory and Integration *I and II, 3 each*
Elements of topology and linear analysis. Lebesgue measure and integration in R, in R^n, and in abstract spaces. Convergence theorems. Bounded variation, absolute continuity, and differentiation. Lebesgue-Stieltjes integral. Fubini and Tonelli theorems. The classical Banach spaces. *(Lec. 3) Prerequisite: MTH 336.* Staff

545, 546 Ordinary Differential Equations I, II *I and II, 3 each*
Existence and uniqueness theorems. Continuous dependence on parameters and initial conditions. Singularities of the first and second kinds, self-adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems. Elements of asymptotic theory. Elements of stability theory of Lyapunov's second method. *(Lec. 3) Prerequisite: MTH 335 and 462.* Staff

550 Advanced Probability *I, 3*
Investigation in depth of a topic in foundations or applications of modern probability theory. *(Lec. 3) Prerequisite: MTH 456.* Staff

551 Advanced Mathematical Statistics I *I, 3*
A thorough development of classical and modern statistics: sampling theory, asymptotic sampling, theory for large samples and exact sampling distributions. The theory of estimation including unbiased estimates, consistent estimates, sufficient statistics, non-parametric and parametric statistics and multidimensional confidence regions. Utility of the theory illustrated by applications from various fields. *(Lec. 3) Prerequisite: MTH 452, 335, or permission of instructor. MTH 335 may be taken concurrently.* Staff

552 Advanced Mathematical Statistics II *II, 3*
Continuation of MTH 551: tests of significance, sample hypothesis, composite hypothesis, most powerful tests, unbiased tests, analysis of variance, regression and multiple regression. Utility of the theory illustrated by applications from various fields. *(Lec. 3) Prerequisite: MTH 551.* Staff

561 Advanced Applied Mathematics *II, 3*
Linear spaces, theory of operators, Green's functions, eigenvalue problems of ordinary differential equations. Application to partial differential equations. *(Lec. 3) Prerequisite: MTH 461.* Staff

562 Complex Function Theory *I, 3*
Analytic continuation, Riemann surfaces. The theory of conformal mapping. Representation theorems and applications. Entire functions. *(Lec. 3) Prerequisite: MTH 462.* Staff

572 Numerical Analysis *II, 3*
Further numerical methods of solution of simultaneous equations, partial differential equations, integral

equations. Error analysis. *(Lec. 3) Prerequisite: MTH 472.* Staff

591, 592 Special Problems *I and II, 1-3 each*
Advanced work, under the supervision of a member of the department and arranged to suit the individual requirements of the student. *Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

601 Seminar *I and II, 3*
A graduate seminar in the field of specialization of a member of the department. *Prerequisite: permission of department.* Staff

629, 630 Functional Analysis I, II *I and II, 3 each*
Banach and Hilbert spaces, basic theory. Bounded linear operators, spectral theory. Applications to analysis. Application to a special topic such as differential operators, semigroups and abstract differential equations, theory of distributions, or ergodic theory. *(Lec. 3) Prerequisite: MTH 536 and permission of instructor.* Staff

635, 636 Selected Topics in Real Analysis I, II *I and II, 3 each*
Advanced topics of current research in real analysis will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

641 Partial Differential Equations I *I, 3*
First order systems. The Cauchy-Kowalewsky theorem. The Cauchy problem. Classification of partial differential equations. Hyperbolic equations. Mainly the theory of the subject. Students interested in techniques for the solution of standard equations should take MTH 441. *(Lec. 3) Prerequisite: MTH 215, 335, and 462.* Staff

642 Partial Differential Equations II *II, 3*
Elements of potential theory. Elliptic equations. Green's function. Parabolic equations. Introduction to the theory of distributions. *(Lec. 3) Prerequisite: MTH 641.* Staff

645, 646 Selected Topics in Differential Equations I, II *I and II, 3 each*
Advanced topics of current research in differential equations will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

659, 660 Selected Topics in Applied Mathematics I, II *I and II, 3 each*
Advanced topics of current research in applied mathematics will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

691, 692 Special Topics I, II *I and II, 3 each*
Advanced topics of current research in mathematics will be presented with a view to expose the students to the frontiers of the subject. *(Lec. 3) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

901 Mathematics Colloquium *I and II, 0*
Current topics in various fields of mathematics, given by special lecturers. *Prerequisite: permission of department.* Staff

MECHANICAL ENGINEERING AND APPLIED MECHANICS (MCE)

417 (or ELE 417) Direct Energy Conversion *II, 3*

423 Design of Machine Elements *I, 3*

424 Dynamics of Machines *I, 3*

425 Lubrication and Bearings *I, 3*

426 Advanced Mechanics of Materials *II, 3*

428 Mechanical Control Systems *II, 3*

429 Comprehensive Design *II, 3*

437 Rocket Propulsion *II, 3*

438 Internal Combustion Engines *I, 3*

439 Applied Energy Conversion *II, 3*

448 Heat and Mass Transfer *I, 3*

455 Advanced Fluid Mechanics *I, 3*

457 (or OCE 457) Fluidics *II, 3*

463 Intermediate Dynamics *I, 3*

464 Vibrations *II, 3*

491, 492 Special Problems *I and II, 1-6 each*

501, 502 Graduate Seminar *I and II, 1 each*
Participation in seminar discussions, presentation of papers based on research or detailed literature surveys. Attendance is required of all students in graduate residence. A maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence. *(Lec. 1)* Staff

517 (or ELE 517) Magnetofinidmechanics *I or II, 3*
Formulation of the basic concepts and equations governing the interaction between electromagnetic fields

and a moving, electrically conducting, continuum fluid. Wave motions in MFM systems and engineering applications. *(Lec. 3) Prerequisite: MCE 455 and ELE 511 or PHY 431, or permission of instructor.* Lessmann

521 Reliability Analysis and Prediction *II, 3*
Statistical analysis of failure of complex engineering systems, design factors contributing to functional system survival, failure, distribution functions, redundancy, confidence, reliability testing. *(Lec. 3) Prerequisite: MTH 451 or equivalent, MCE 423 or permission of instructor.* Nash

524 Advanced Kinematics and Linkage Design *I, 3*
Systematics of mechanisms and synthesis of linkage design. *(Lec. 3) Prerequisite: MCE 423.* Hatch

531 Underwater Power Systems
See Ocean Engineering 531.

532 Coastal Zone Power Plants
See Ocean Engineering 532.

540 Environmental Control in Ocean Engineering
See Ocean Engineering 540.

541 Thermodynamics *I, 3*
Advanced study of classical thermodynamics with emphasis on basic concepts, laws, and thermodynamic relations. *(Lec. 3) Prerequisite: MCE 341, 354.* Brown and Wilson

542 Statistical Thermodynamics *II, 3*
Irreversible thermodynamics, kinetic theory of gases, statistical thermodynamics and the development and application of the partition function. *(Lec. 3) Prerequisite: MCE 341.* Wilson

545 Heat Transfer *I, 3*
Conduction in two and three dimensions and conducting systems with radiation and fluid motion. Solutions obtained by mathematics, computer-numerical methods, and analog devices. *(Lec. 3) Prerequisite: MCE 448.* Schenck

546 Convection Heat Transfer *II, 3*
Study of the relationship between heat transfer and fluid flow with emphasis on the solution of governing equations by exact methods, integral methods and similarity techniques. *(Lec. 3) Prerequisite: MCE 448.* Test

550 Theory of Continuous Media *I, 3*
Basic course for first-year graduate students which develops and unifies the laws of mechanics as applied to the behavior of continua. Application to solids and fluids. *(Lec. 3) Prerequisite: CVE 220, MCE 354, 372, or permission of instructor.* Dowdell and Kim

551 Hydrodynamics *I, 3*
Fundamental concepts of inviscid fluid motion. Rotational and irrotational flows. Applications to rotating fluids, flow around bodies, and other incompressible flows. *(Lec. 3) Prerequisite: MCE 354.* Dowdell, Hagist, and White

552 Hydrodynamics of Viscous Fluids *II, 3*
Fundamental equations of viscous, heat conducting flow. Application to exact viscous solutions, stability and transition, laminar and turbulent boundary layers, heat convection, diffusion, and dissipation. *(Lec. 3) Prerequisite: MCE 551.* Dowdell, Hagist, and White

563 Advanced Dynamics *I and II, 3*
Dynamics of a system of particles, D'Alembert's principle and Lagrange's equations from an advanced point of view. Variational methods, non-conservative and non-holonomic systems; matrix-tensor specifications of rigid body motions, inertia tensor, tops and gyroscopes. General theory of small oscillations of a system of particles, normal coordinates. Hamilton's equation of motion, canonical transformation, Hamilton-Jacobi theory. *(Lec. 3) Prerequisite: MCE 463 or permission of instructor.* Velletri and Nash

564 Advanced Vibrations *I, 3*
Theory of vibration of systems with concentrated masses and stiffness; systems with one degree of freedom, vibration isolation systems with many degrees of freedom, matrix methods, dynamic vibration absorbers, torsional vibration, approximate numerical methods and mobility and impedance methods. Experimental methods and design procedures. *(Lec. 3) Prerequisite: MCE 464.* Bradbury and Nash

565 Advanced Vibrations *II, 3*
Theory of vibration with continuously distributed mass and stiffness. Wave, characteristic function and integral equation methods of solution of string, longitudinal and torsional systems. Vibration and critical speeds of beams and rotating shafts, the methods of Rayleigh, Ritz, and Stodola, and self-excited vibrations. *(Lec. 3) Prerequisite: MCE 564.* Bradbury and Nash

572 Theory of Elasticity *II, 3*
Advanced theory of elasticity of isotropic and anisotropic bodies; plane stress and plane strain analysis via classical and Muskhelishvili's method, three-dimensional applications in torsion, bending, and semi-infinite solids. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Kim

573 Theory of Plates *I and II, 3*
Development of classical theory of plates and application to plates of various shapes under various loadings; buckling and large deflections. *(Lec. 3) Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff, Nash, and Staff

575 Elastic Stability *I and II, 3*
Stability analysis of bars under separate and combined axial, lateral, and torsional loadings; buckling of plates and shells, energy methods and numerical

methods. *(Lec. 3) Prerequisite: CVE 220, MTH 244, MCE 372, or permission of instructor.* Goff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

645 Boiling Heat Transfer and Two-phase Flow
See Chemical Engineering 645.

646 (or CHE 646) Radiation Heat Transfer *I or II, 3*
Radiant exchange between surfaces. Radiative properties of surfaces. Exchange among non-ideal surfaces. Gas-radiative exchange. Radiative exchange with volume emitters. Furnace design applications. *(Lec. 3) Prerequisite: MCE 545 or CHE 644 or permission of instructor.* Brown

654 Statistical Theories of Turbulence *I, 3*
Analytical description of random phenomena; three-dimensional space-time correlations. Theories of turbulence including anisotropy and non-homogeneity. Applications to meteorology, boundary layers, and turbulent diffusion. *(Lec. 3) Prerequisite: MCE 552 or permission of instructor.* Hagist

655 Viscous Compressible Flow *II, 3*
Flow of real fluids at extremely high speeds, with emphasis on the development of basic physical relations. Application to several problems in space technology. *(Lec. 3) Prerequisite: MCE 541, 545, 551.* Dowdell, Hagist, and White

656 Flow of Compressible Fluids *II, 3*
Fundamental equations of compressible fluid flow. Solution of these equations for flows at high subsonic and supersonic velocities. *(Lec. 3) Prerequisite: MCE 551 or permission of instructor.* Hagist, White, and Staff

666 Nonlinear Mechanics *I and II, 3*
Dynamics of nonlinear systems, free and forced oscillations; graphical methods, integral curves, singular points, limit cycles and stability. Van der Pol and Hill equations, perturbation methods, approximate methods of Duffing, Poincaré, Kryloff and Bogoliuboff. *(Lec. 3) Prerequisite: MCE 564.* Nash and White

673 Thermal Stress Analysis *I, 3*
Theory of stress and deformation in bodies subjected to thermal environments and restraints. Application to problems in thermoelasticity, thermal fatigue, thermoplasticity, and creep analysis. *(Lec. 3) Prerequisite: MCE 448, 550.* White and Kim

674 Theory of Shells *I and II, 3*
Development and application of membrane and bending theories of shells of various shapes. Variational methods and buckling of shells. *(Lec. 3) Prerequisite: CVE 220, MCE 573, or permission of instructor.* Kim

677 Fatigue Failure and Fracture Mechanics *II, 3*
Advanced study of fracture induced by repeated loading, damage theories, fundamental theories of microscopic crack initiation and growth, statistical aspects of fatigue failure, theory of crack propagation. *(Lec. 3) Prerequisite: MTH 451, MCE 429, 550, or permission of instructor.* Nash

679 Plasticity and Creep *II, 3*
Stress-induced flow of nominally solid materials, effect of temperature, combined stress problems; stress-dependent creep of metals at elevated temperatures, creep buckling, anelastic creep, related dislocation theory. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Goff

691, 692 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem.) Credits not to exceed a total of 12. Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

MEDICINAL CHEMISTRY (MCH)

443, 444 Organic Medicinal Chemistry *I and II, 3 each*

497, 498 Special Problems *I and II, 1-5 each*

501 Radiopharmaceuticals *I, 3*
The theoretical and applied aspects of the commonly used isotopes of pharmaceutical significance with emphasis on the diagnostic, therapeutic, and tracer applications in biological systems and techniques of development, formulation, quality control, and safe utilization. *(Lec. 2, Lab. 3) Prerequisite: CHM 222, PHY 112 and MCH 334 or permission of department.* Smith

526 Lipid Chemistry
See Food and Resource Chemistry 526.

533 Advanced Drug Assay *I and II, 2-4*
Advanced chemical and physical methods of analytical control related to pharmaceutical research and industrial pharmacy. *(Lec. 1, Lab. 3-9) Prerequisite: MCH 339.* Smith

548 (or PCG 548) Physical Methods of Identification *II, 3*
The utilization of physical methods (primarily spectroscopic) in the structure elucidation of complex organic molecules. Emphasis on interpretation of ultraviolet, infrared, nuclear magnetic resonance, mass and optical rotatory dispersion spectra. *(Lec. 3) Pre-*

requisite: CHM 425 and/or permission of instructor. Turcotte, Tashiro, Shimizu, Abushanab

549 Synthesis *I and II, 3*
Theoretical and applied aspects in synthesis of selected organic compounds of medicinal significance. *(Lab. 9) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621, 622 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on selected topics in medicinal chemistry. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. No more than 3 credits allowed for the entire period of residence.* Staff

643 Advanced Organic Medicinal Chemistry *II, 3*
Synthesis, modes of action, and effects on pharmacological activity. Analgesics, cholinergics, folic acid antagonists, diuretics, and sulfonamides are included. *(Lec. 3) Prerequisite: CHM 422 and permission of instructor. In alternate years, next offered 1971-72.* Turcotte

646 Alkaloids *I, 3*
Advanced course dealing with proof of structure, synthesis, chemical properties and biological activity of various alkaloids. *(Lec. 3) Prerequisite: permission of department.* Abushanab

697, 698 Research in Medicinal Chemistry
I and II, 1-3 each
Literature survey, laboratory work and a detailed research report on one or more assigned topics in medicinal chemistry. *(Lab. 3-9) Prerequisite: permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

MUSIC (MUS)

LITERATURE AND HISTORY

407 The Symphony *II, 3*

408 The Opera *II, 3*

431 The Baroque Era *I and II, 3*

432 The Classical Era *II, 3*

433 The Romantic Era *I, 3*

481, 482 Piano Literature and Pedagogy
I and II, 2 each

THEORY AND COMPOSITION

418 Composition *II, 3*

419 Composition *I, 2*

420 Counterpoint *II, 3*

422 Advanced Orchestration *II, 2*

427, 428 Sixteenth-Century Counterpoint
I and II, 2 each

441 Special Projects *I and II, 3*

APPLIED MUSIC

451 to 454 Applied Music as Minor or Elective
I and II, 1-2 each

461 to 464 Applied Music Major *I and II, 4 each*

MUSIC EDUCATION

445 Music in the Elementary School *II, 3*

NUCLEAR ENGINEERING (NUE)

538 (or CHE 538) Nuclear Metallurgy *II, 3*
Metallic materials of particular interest in nuclear engineering. The production and physical metallurgy of uranium, thorium, the transuranium elements, and the rare earths; protection against corrosion, radiation damage. *(Lec. 3) Prerequisite: CHE 332.*

581 (or CHE 581) Introduction to Nuclear Engineering *I and II, 3*
Survey course to acquaint students with the field and to emphasize the special application of principles learned in the several specialized branches of engineering. Major topics considered are nuclear physics, problems in the design of reactor cores, materials of construction, instrumentation and control, and health physics. *(Lec. 3) Prerequisite: PHY 340 or 341.* Knickle

582 (or CHE 582) Radiological Health Physics *I, 3*
Fundamentals of health physics and radiation protection are covered. Calibration and use of survey and monitoring equipment are emphasized in the laboratory. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor. In alternate years.* Rose

583 (or CHE 583) Nuclear Reactor Theory *II, 3*
Elementary theory of self-sustained nuclear reactors. Diffusion and slowing-down theory of neutrons and the determination of the critical size and homogeneous thermal reactors with and without reflectors. One-group, two-group and modified two-group approaches

are emphasized. *(Lec. 3) Prerequisite: PHY 340 or 341.* Knickle

585 (or CHE 585) Measurements in Nuclear Engineering *I, 3*
Basic techniques used in measuring the interaction of radiation and matter. Principles of ionization chambers, proportional and Geiger-Mueller counters, scintillation counters as well as the related circuitry are presented. Laboratory work stresses a thorough familiarization with the use of these instruments. *(Lec. 2, Lab. 3) Prerequisite: PHY 340 or 341 or permission of department.* Rose

586 (or CHE 586) Nuclear Reactor Laboratory *II, 3*
Theoretical and experimental determination of reactor characteristics. Experimental equipment includes a neutron howitzer, a subcritical training reactor and a one megawatt swimming pool reactor. Digital and analog computer facilities are utilized in calculations. *(Lec. 1, Lab. 4) Prerequisite: NUE 585.* Rose

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

682 (or CHE 682) Radiation Shielding *II, 3*
Detailed study of the problems involved in radiation shielding. The principles of radiation protection are briefly reviewed first. *(Lec. 3) Prerequisite: NUE 581. In alternate years.* Knickle

683 (or CHE 683) Advanced Nuclear Reactor Theory *II, 3*
Advanced treatment of nuclear reactor theory, emphasizing the transport theory and multi-group calculations. Determination of critical size of heterogeneous reactors. Time-dependent transient behavior and basic theory of reactor control are also discussed. Use of digital and analog computers is incorporated. *(Lec. 3) Prerequisite: NUE 583.* Rose

687 (or CHE 687) Nuclear Chemical Engineering *II, 3*
Applications of chemical engineering to the processing of materials for and from nuclear reactors. *(Lec. 3) Prerequisite: NUE 581 and permission of instructor. In alternate years.* Rose

NURSING (NUR)

501, 503 Advanced Clinical Nursing *I or II, 3 each*
Cross-clinical seminar through which the graduate student is helped to broaden and deepen knowledge of theory, concepts and problems that are common to all nursing. *(Lec. 3) Must be taken concurrently with NUR 502, 504.* Staff

502, 504 Advanced Clinical Nursing Practicum *I or II, 3 each*
Intensive study of significant nursing problems in health agencies, selected cooperatively by student and instructor with regard to student's needs and interests. A substantial paper involving independent study in NUR 501, 502, 503, 504 is required. *(Lec. 1, Lab. 6) Must be taken concurrently with NUR 501, 503. Required of all graduate students in nursing.* Staff

505 Research in Nursing *I, 3*
Current research in nursing, emphasizing interpretation and applications. Methodology related to clinical nursing and community health. Students select a problem and develop a project as a learning experience. *Prerequisite: graduate standing and a basic course in statistics.* Staff

510 Teaching in Clinical Nursing *I or II, 3*
A seminar in which the student is assisted in planning, developing, implementing and evaluating classroom and clinical teaching. *(Lec. 3) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 511.* Staff

511 Teaching Practicum *I or II, 3*
Supervised teaching experience in student's major field of interest. *(Lec. 1, Lab. 6) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 510.* Staff

512 Administration in Nursing Service *I or II, 3*
A seminar in which the student is assisted in the development of the philosophy and processes in administration as they relate to nursing service and nursing education. *(Lec. 3) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 513.* Staff

513 Practicum in Administration of Nursing Service *I or II, 3*
Directed experience in nursing service in the student's major field of interest. *(Lec. 1, Lab. 6) Prerequisite: NUR 501, 502. Must be taken concurrently with NUR 512.* Staff

OCEAN ENGINEERING (OCE)

457 Fluidics *II, 3*

500 Basic Ocean Engineering *I and II, 3*
Introduction for non-engineering students to the classic engineering disciplines as they relate to marine affairs. Course is descriptive and deals with current engineering practice. *(Lec. 3) Prerequisite: senior standing. No program credit for graduate engineering students.* Sheets

512 Hydrodynamics of Floating and Submerged Bodies I *I, 3*
Hydrodynamic principles associated with floating and submerged bodies: resistance, propulsion, static and dynamic stability. *(Lec. 3) Prerequisite: MCE 455 or equivalent.* Kowalski

513 Hydrodynamics of Floating and Submerged Bodies II *II, 3*
Continuation of OCE 512. Problems of maneuvering, control, and motions in waves. *(Lec. 3) Prerequisite: OCE 512.* Kowalski

~~521~~
524 Marine Structural Design
See Civil Engineering 524.

531 (or MCE 531) Underwater Power Systems *II, 3*
Low output power systems. Overall considerations appropriate to the determination of power requirements for underwater systems. *(Lec. 3) Prerequisite: MCE 342, 448 or permission of instructor.* Brown and Rose

532 (or MCE 532) Coastal Zone Power Plants *I, 3*
Overall systems consideration for coastal zone power plants. Consideration of factors such as political and legal problems, thermal pollution, and multi-use of plants (aquaculture, etc.). *(Lec. 3) Prerequisite: MCE 342, 448 or permission of instructor.* Brown and Rose

534 Corrosion and Corrosion Control
See Chemical Engineering 534.

535 Advanced Course in Corrosion
See Chemical Engineering 535.

540 (or MCE 540) Environmental Control in Ocean Engineering *II, 3*
Application of the principles of thermodynamics, heat transfer, and fluid dynamics to the requirements of human survival and engineering operations in deep and shallow water. *(Lec. 3) Prerequisite: permission of instructor.* Schenck

561 Introduction to the Analysis of Oceanographic Data *I, 3*
Design of oceanic experiments to determine spatial and temporal sampling rates, precision, accuracy, signal-to-noise ratio, etc. Description of typical ocean data collection and analysis systems. Development of relevant techniques. *(Lec. 3) Prerequisite: MTH 451 or equivalent.* LeBlanc

~~585 586~~ 5-566

571 (or ELE 571) Underwater Acoustics I *I, 3*
Wave equation, energy, pressure and particle velocity. Acoustic properties of the sea. Elementary sources, refraction, reflection, ray theory, normal modes and scattering, with emphasis on sound propagation in the ocean. *(Lec. 3)* Moffett, DiNapoli

581 Coastal Engineering Geology
See Geology 581.

587 Submarine Soil Mechanics *I, 3*
Soil mechanics principles as applied to submarine slope stability, heaving, sinkage and anchorage problems with emphasis on effective stress principle and selection of shear strength of marine sediments. *(Lec. 3) Prerequisite: CVE 380 or equivalent.* Nacci

591, 592 Special Problems *I and II, 1-6 each*
Advanced work, under the supervision of a member of the staff and arranged to suit the individual requirement of the student. *(Lec. or Lab. according to nature of problem.) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

605, 606 Ocean Engineering Seminar *I and II, 1 each*
Seminar discussions including presentation of papers based on research or literature survey. *(Lec. 1) Attendance is required of all students in graduate residence. A maximum of 1 credit per year is allowed and no more than 2 credits are allowed for the entire period of residence.* Staff

610 Engineering Ocean Mechanics *II, 3*
Applied concepts of ocean flow processes; waves due to gravity, wind, and layered media; large and small scale turbulence; prediction of flow instability; wave forces on structures. *(Lec. 3) Prerequisite: CHE 344, MCE 354 or equivalent.* White

651, 652 Advanced Design *I and II, 3 each*
Advanced course coordinating engineering principles and economics in the design of a complete ocean engineering device. Problems investigated individually with the guidance of one or more instructors. *Prerequisite: CHE 351, 352 or IDE 404 or equivalent.* Staff

653, 654 Ocean Engineering System Studies *I and II, 3 each*
Systems engineering study of an advanced ocean engineering problem. Students will operate as a complete engineering team with specific subsystems designs done with individual faculty members. Sheets

672 (or ELE 672) Underwater Acoustics II *II, 3*
Transducers, radiators and receivers, directivity (array structures) equivalent circuits, efficiency; piezoelectricity, magnetostriction, sonar principles, measurements and calibration. *(Lec. 3)* Moffett, DiNapoli

673 Advanced Course in Underwater Acoustic Propagation *I, 3*
Analysis of propagation from a concentrated acoustic source in the ocean by methods such as advanced normal mode theory, numerical integration and fast Fourier transforms. Applications to ocean features such as surface ducts, shadow zones, deep sound channel, etc. *(Lec. 3) Prerequisite: OCE 571 or equivalent.* DiNapoli

691, 692 Special Problems *I and II, 1-6 each*
Advanced work under supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem.) Prerequisite: permission of department.* Staff

~~693~~

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

OCEANOGRAPHY (OCG)

401 General Oceanography *I, 3*

501 Physical Oceanography *I, 3*
Basic course covering all aspects of physical oceanography. Physical properties of seawater, heat budget, distribution of variables, dynamics, water masses and general circulation. Waves, tides, history and interrelationships with other marine sciences. *(Lec. 3) Prerequisite: PHY 213, MTH 141.* Knauss and Kenyon

509 Ecological Aspects of Marine Pollution *II, 2*
Biological, chemical, and physical aspects of selected agricultural, industrial, and domestic effluents in the marine and estuarine environment. Case histories emphasizing toxicological effects. The concept of bioassay as an analytical tool is developed through demonstrations and discussion. *(Lec. 2) Prerequisite: OCG 401 or permission of instructor.* Eisler

510 Descriptive Physical Oceanography *II, 3*
Observed distributions of temperature, salinity, currents; methods of deducing deep flow; physical properties of seawater; flow in estuaries; practical work in the analysis of oceanographic data; study of recent literature. *(Lec. 3) Prerequisite: OCG 501. In alternate years, next offered 1971-72.* Sturges

521 Chemical Oceanography *II, 3*
Processes regulating the composition of sea water, and the distribution of chemical species. The interaction of marine chemistry with the ocean floor, atmosphere and marine organisms. *(Lec. 2, Lab. 2) Prerequisite: CHM 103, 104 and 112, PHY 213.* Pilson

540 Geological Oceanography *II, 3*
Survey of marine geology and its relationship to other marine sciences. Beaches and coastal evolution; geomorphology, sedimentary processes, structure, volcanism and tectonics of continental margins, ocean basin floor, and mid-oceanic ridges; origin of ocean basins. Laboratory emphasizes instrumentation, procedures and the interpretation of marine geological data. *(Lec. 2, Lab. 2) Prerequisite: GEL 103 or ESC 105 or permission of instructor.* McMaster

561 Biological Oceanography *I, 3*
Nature of life in the sea; adaptations, patterns of distribution and production of plankton, nekton and benthos, their interrelationships and interaction with the environment. *(Lec. 2, Lab. 2) Prerequisite: ZOO 111.* Pratt

567 Marine Bacteriology *I, 3*
Present concepts of the distribution, nature, and functions of bacteria and related microorganisms in the marine environment. Methodology will include sampling, culture, taxonomy and study in regard to their physical and physiological ecology. *(Lab. 6) Prerequisite: CHM 104 and BAC 201, or permission of instructor.* Sieburth

568 Fishery Biology *II, 3*
Biology of fish populations and methods of fishery research, including influence of environmental factors on morphology, physiology, abundance and distribution of fishes, estimation of stocks, growth, aging, mortality, measurement of fish production and theory of fishery regulation. *(Lec. 3) Prerequisite: permission of instructor. In alternate years, next offered 1971-72.* Saila

571 Benthic Environment *I, 3*
Lectures, readings, seminar presentations, discussion and project work on the physical-chemical properties and the total ecology of the benthic marine environment. Includes tidal marshes, rocky intertidal areas, estuarine shoals, coral reefs and the deep-sea benthos. *(Lec. 2, Lab. 2) Prerequisite: permission of instructor.* Nixon

574 Biology of Marine Mammals *II, 2*
Migration, reproduction, social organization, classification, anatomy, populations, physiology and communications of cetaceans and pinnipeds. *(Lec. 1, Lab. 3) Prerequisite: permission of instructor. In alternate years, next offered 1972-73.* Winn

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

605 Dynamical Oceanography *I, 3*
Simple steady state theories applied to ocean motion. Review of well-known force balances in oceanography, wind driven circulation, thermohaline circulation, the thermocline, oceanic boundary layers, near shore circulation, diffusion. *(Lec. 3) Prerequisite: OCG 501.* Kenyon

611 Geophysical Hydrodynamics *II, 3*
Fluid dynamics of rotating bodies with application to earthy phenomena. Figure of the earth. Conservation laws and rotational constraints. Geostrophic and quasi-geostrophic motion. Hydrodynamic instability applied to generation of surface gravity waves. Laminar and turbulent Ekman boundary layers. Wind-driven ocean circulation. Waves and circulation caused by density variations. *(Lec. 3) Prerequisite: permission of instructor.* Stern

612 Experimental Geophysical Hydrodynamics *I, 3*
Laboratory experiments relating to the motion of oceans and atmospheres. Comparison of effects of rotation and stratification. Selected topics of thermal convection, thermohaline convection, inertial waves,

rotational and boundary layer phenomena. Emphasis on experimental research techniques and preparation of technical reports. *(Lec. 2, Lab. 3) Prerequisite: permission of instructor.* Lambert

613 Waves *I, 3*
Generation, propagation and decay of surface waves, internal waves, and Rossby waves in the ocean. *(Lec. 3) Prerequisite: MCE 550 or permission of instructor.* Kenyon

614 Tides *II, 1*
Generation, propagation, and dissipation of ocean tides. Relation between theory and observation. *(Lec. 1) Prerequisite: OCG 501.* Kenyon

621 The Estuary and Coastal Zone *I, 3*
Multi-disciplinary course on the characteristics of estuaries and adjacent coastal waters and the ecological, economic, engineering and other considerations applicable to the development, management, and conservation of such waters. *(Lec. 2, Rec./Proj. 1) Prerequisite: advanced (second year) graduate standing and approval of course chairman.* Marshall and Lampe

623 Physical Chemistry of Seawater *I, 3*
The characterization of dissociation, solubility and redox equilibria in seawater. Partial molar volumes, conductivity and diffusion of ions in seawater. Kinetic studies in seawater and the effects of temperature, salinity and pressure on physicochemical properties in seawater. *(Lec. 3) Prerequisite: OCG 521 and CHM 332 or permission of instructor.* Kester

625 Organic Geochemistry *I, 3*
Chemistry of biological compounds in sedimentary organic matter based on their origin, classification and diagenesis. *(Lec. 3) Prerequisite: CHM* 228. J. G. Quinn

630 Geochemistry *II, 3*
Introduction to the study of the distribution of the elements in the natural environment. Emphasis is placed upon an understanding of the chemical principles and chemical processes which govern this distribution. *(Lec. 3) Prerequisite: CHM 104 or 112 and GEL 103 or permission of instructor.* Schilling

631 Seminar in Marine Chemistry *I and II, 1*
Discussion of problems of current interest in marine chemistry. *(Lec. 1) Prerequisite: OCG 521 or permission of instructor.* Staff

643 Seminar in Deep-sea Geology *I, 3*
Class discussion of selected topics in deep-sea geology based on extensive reading in the scientific literature. A research paper by each student and lectures will supplement the discussions. *(Lec. 3) Prerequisite: permission of instructor.* Krause

644 Thermodynamics of the Earth's Interior *II, 3*
Review and application of thermodynamics to geological problems. Crystal-melt equilibria, phase transitions, hydration reactions; coprecipitation laws and fractionation processes; effect of the geothermal and pressure gradients, convection. *(Lec. 3) Prerequisite: GEL 103 and a course in thermodynamics such as CHM 433, or PHY 420, or CHE 313 and 314, or MCE 341 or permission of instructor.* Schilling

645 Geology of Continental Margins *I, 3*
Geomorphology, sedimentology and structure of continental shelves, borderlands, slopes and rises with consideration of origin and developmental processes of continental margins. *(Lec. 3) Prerequisite: OCG 540, GEL 470 and 550. Offered in fall of odd calendar years.* McMaster

647 Recent Sedimentary Environments *I, 3*
Concentrated study of the sedimentary environments of beach, estuary, continental shelf, slope, and rise, with primary emphasis on the relationships between the sediment properties of each environment and its environmental conditions. *(Lec. 3) Prerequisite: OCG 501, 540, GEL 550. Offered in the fall of even calendar years.* McMaster

648 Marine Paleoecology *II, 4*
Concepts of paleoecology. Review of Pleistocene and Tertiary paleo-oceanography, paleoclimatology and paleoecology. Criteria and methods used in marine paleoecology, especially those related to foraminifera and radiolaria. Deep-sea biogenic sediments and their relation to oceanic processes such as solution, productivity and dilution. *(Lec. 3, Lab. 1) Prerequisite: permission of instructor. Research term paper.* Kennett

661 (or BOT 661) Phytoplankton Taxonomy *I, 3*
Classical and modern systems and techniques for the identification, nomenclature, and classification of planktonic algae, with emphasis on marine forms. Phylogeny will be briefly considered. *(Lec. 1, Lab. 4) Prerequisite: permission of instructor. In alternate years, next offered fall 1972.* Hargraves

662 Ecological Concepts in Marine Research *II, 3*
Advanced course in ecology with emphasis on marine environment. Ecological theory pertaining to population dynamics, energy in ecological systems and the application of quantitative biology in oceanography. Application of experimental methods in ecological research. *(Lec. 3)* Jeffries

663 (or BOT 663) Phytoplankton Physiology *I, 3*
Metabolic processes and methods of their investigation in phytoplankton with primary emphasis on functions pertinent to their ecology. Includes adaption, uptake of nutrients, excretion, rhythms, pigments, and photosynthesis. *(Lec. 3) Prerequisite: permission of instructor.* Swift

664 (or BOT 664) Phytoplankton Ecology *II, 4*
Biology, ecology, methods of investigation and introductory systematics of the pelagic marine microscopic

plants; stress on their adaptations, physiological ecology, distribution, succession, production, and regional and seasonal dynamics. *(Lec. 3, Lab. 3) Prerequisite: permission of instructor.* Smayda

666 Zooplankton *I, 3*
Biology of marine zooplankton, dealing with morphology, adaptation, distribution, physiology, production and interrelationships with other members of the marine biota. *(Lec. 1, Lab. 4) Prerequisite: permission of instructor.* Napora

667, 668, 669 (or BOT 667, 668, 669) Advanced Phytoplankton Seminars *II, 2 each*
Specialized and advanced areas of phytoplankton biology and research, including systematics, physiology and ecology. *(Sem. 3) Prerequisite: permission of instructor.* Hargraves, Smayda and Swift

672 Marine Invertebrates and Environment *II, 3*
Physiological responses of marine invertebrates to seasonal and geographical changes in the environment. Survival, metabolism, reproduction and larval development of the populations. Mechanisms in adaptation during all stages in the life cycle will be examined in relation to changes of certain environmental factors. Physiological variation of populations as it relates to the speciation process in the sea. Lectures, reading and discussion from the literature. A research project is expected of each student. *(Lec. 3) Prerequisite: OCG 561 and permission of instructor.* Sastry

673 Advanced Animal Behavior *II, 4*
Animal communication with some emphasis on bioacoustics, circadian rhythms, orientation and related topics. *(Lec. 2, Lab. 4) Prerequisite: permission of instructor. In alternate years, next offered 1972-73.* Winn

683 Quantitative Genetics I
See Genetics 683.

684 Quantitative Genetics II
See Genetics 684.

691, 692 Individual Study *I and II, 1-6 each*
Individual study of assigned topics or special problems, involving literature search and/or original investigation under one or more members of the staff. *(Lec., Lab. TBA)* Staff

693, 694 Special Studies *I and II, 1-4 each*
Studies of specialized topics in the marine sciences. *(Lec., Lab. TBA)* Staff

695 Seminar in Oceanography *I and II, 1 each*
Students to give seminar reports on problems and current research in various areas of oceanography. *(Lec. 1)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

ORGANIZATIONAL MANAGEMENT AND INDUSTRIAL RELATIONS (OMR)

407 (MGT 407) Administrative Practices *I, 3*

422 (MGT 422) Labor Legislation *II, 3*

423 (MGT 423) Industrial Relations *II, 3*

431 (MGT 431) Advanced Management Seminar *I, 3*

491, 492 (MGT 491, 492) Special Problems *I and II, 3 each*

504 (MGT 504) Business Policy *II, 3*
Determination of objectives and planning programs of action, creating an organization and launching a program; controlling execution of plans; reappraising objectives. These goals are attained through emphasizing administrative situations as described in cases. *Prerequisite: completion of 42 credit hours in MBA program or permission of department. MBA students only.* Staff

631 (MGT 631) Personnel Management *I and II, 3*
The role of personnel management and its functional relationship within an organization with emphasis on behavioral concepts and their application. Text, cases and research. *(Lec. 3)* Raffaele

632 (MGT 632) Managerial Economics *I and II, 3*
Mathematics, statistics, and econometrics as tools in dealing with typical problems of managerial economics; application of economic concepts to decision-making of the firm. *(Lec. 3) Prerequisite: ECN 900, MGS 980, BST 981, or equivalent.* Staff

638, 639 (MGT 638, 639) Seminar in Industrial Management *I and II, 3 each*
Class discussion of typical cases, original research work in the field of industry with discussion of data collected and analyzed by individual students. *(Lec. 3) Prerequisite: permission of department.* Staff

930 (MGT 930) Principles of Management *I and II, 3*
Management applied to business; objectives, policies, organization, staffing and control; production personnel, behavioral science applications; the role of quantitative methods. *(Lec. 3) Graduate credit for matriculated MBA students only.* Overton

PHARMACOGNOSY (PCG)

445, 446 General Pharmacognosy *I and II, 4 each*

459 (359) Public Health *I, 3*

497, 498 Special Problems *I and II, 1-3 each*

521, 522 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on selected topics in pharmacognosy. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits allowed for entire period of residence.* Staff

533 Medicinal Plants *I and II, 2*
Problems in drug plant chemotaxonomy with field work in the drug plant gardens. Emphasis is placed on certain alkaloid, glycoside and oil-yielding plants. Weedicides and insecticides as related to measures for control. *(Lec. 1, Lab. 3) Prerequisite: PCG 446 or permission of department.* Staff

536 Antibiotics *II, 3*
Advanced course dealing with the concept of antibiosis, biosynthesis pathways of antibiotic production, testing, chemistry, mechanism of action, medicinal and pharmaceutical uses of antibiotics. Phenomena of sensitivity and resistance with emphasis on those entities of importance in pharmaceutical research and production. *(Lec. 3) Prerequisite: permission of department. In alternate years, next offered 1972-73.* Worthen

548 Physical Methods of Identification
See Medicinal Chemistry 548.

551, 552 Chemistry of Natural Products *I and II, 3 each*
Introduction to the chemistry of certain groups of natural products especially in relation to their chemotaxonomic position in plant classification. Topics limited to secondary metabolites: e.g. terpenoids, phenolic compounds, aromatic compounds, phytosterols, and alkaloids. *(Lec. 3) Prerequisite: CHM 228 and 230. In alternate years, next offered 1971-72.* Shimizu and Tashiro

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

633, 634 Biosynthesis *I and II, 3 each*
Biogenesis of medicinally active principles of biological origin. Emphasis given to organic acids, polysaccharides, glycosides, steroids and certain nitrogenous compounds. *(Lec. 3) In alternate years, next offered 1971-72.* Staff

635, 636 Pharmacognosy Techniques *I and II, 3-4 each*
Physical and chemical factors influencing growth and development of active principles of drug plants. Certain biological analyses of results are performed. *(Lec. 1, Lab. 6-9)* Staff

697, 698 Research in Pharmocognosy *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACOLOGY AND TOXICOLOGY (PCL)

441, 442 General Pharmacology *I and II, 4 each*

497, 498 Special Problems *I and II, 1-3 each*

521, 522 Seminar *I and II, 1 each*
Seminar discussions and presentation of papers on selected topics in pharmacology. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. No more than 3 credits are allowed for the entire period of residence.* Staff

542 Evaluation of Drug Effects *II, 5*
Theory, methods and techniques involved in the determination of qualitative and quantitative activity and relative toxicity of drugs. *(Lec. 2, Lab. 9) Prerequisite: PCL 441 and 442, BST 501, or equivalent and permission of department. In alternate years, next offered 1972-73.* DeFanti and DeFeo

544 Forensic Toxicology *II, 3*
Theoretical and practical aspects of poisoning including the isolation and identification of toxic materials from pharmaceuticals, body fluids and tissues. Isolation and identification of physiological fluids from stains, hairs, and tissue with application to forensic medicine. *(Lec. 2, Lab. 3) Prerequisite: PCL 441, 442 and permission of department. In alternate years, next offered 1972-73.* DeFanti

546 Advanced Toxicology *II, 4*
Toxic effects of selected drugs and other xenobiotics on physiological and biochemical processes. *(Lec. 3, Lab. 4) Prerequisite: PCL 441, 442 or equivalent, and permission of department. In alternate years, next offered 1971-72.* Carlson

550 Operant Analysis of Behavior
See Psychology 550.

562 Psychopharmacology *II, 3*
Effects of drugs on animal and human behavior and on related biochemical processes. *(Lec. 3) Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years, next offered 1972-73.* Lal

564 Psychopharmacology Laboratory *II, 1-3*
Laboratory exercises to demonstrate effects of drugs on animal and human behavior. To earn more than one credit, the student will engage in original work of

limited scope. *(Lab. 3-9) Prerequisite: PCL 441 or equivalent and/or permission of department.* Lal

572 Neural Bases of Drug Action *II, 3*
Review of neuroanatomy, neurochemistry, and neurophysiology as they are related to drug action. *(Lec. 3) Prerequisite: PCL 441 or equivalent and/or permission of department. In alternate years, next offered 1971-72.* Lal

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

641 Biochemical Pharmacology *I, 4*
Theory and application of pharmacological studies at the cellular and subcellular levels and their significance to drug action in the intact organism. *(Lec. 3, Lab. 3) Prerequisite: PCL 441 and 442 and permission of department. In alternate years, next offered 1971-72.* Fuller

643 Advanced Pharmacology and Techniques *I, 4*
Mechanism of action of drugs on living tissues, organs and organisms with particular emphasis on cellular physiology as a basis of explanation of tissue response. Advanced laboratory techniques as employed for pharmacological testing. *(Lec. 2, Lab. TBA) Prerequisite: PCL 442, and permission of department. In alternate years, next offered 1972-73.* DeFeo

697, 698 Research in Pharmacology *I and II, 1-5 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY (PHC)

425 History of Pharmacy *I and II, 3*

451 Clinical Pharmacy *I, 3*

497, 498 Special Problems *I and II, 1-3 each*

521, 522 Seminar *I and II, 1 each*
Seminar discussions including presentation of papers on selected topics in pharmacy. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits are allowed for the entire period of residence.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621, 622 Manufacturing Pharmacy *I and II, 2-5 each*
Theory of and practice in the manufacture of pharmaceuticals and the principles of operation of the equipment used for their production. *(Lec. 2, Lab. 0-9)* Gerraughty, Gloor, and Paruta

625, 626 Hospital Pharmacy Administration *I and II, 3 each*
Hospital organizations, including intra- and interdepartmental relationships, the medical and service staff problems, the administrator, personnel management, pharmaceutical service with relation to patient care, medical and pharmaceutical research. *(Lec. 3)* Gerraughty and Paruta

631 Advanced Physical Pharmacy *I, 3-5*
Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents are determined. *(Lec. 3, Lab. 3-6) Prerequisite: CHM 332 or permission of department.* Gerraughty, Gloor and Paruta

632 Advanced Physical Pharmacy *II, 2-4*
Application of physical-chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal and pharmaceutical agents are determined. *(Lec. 2, Lab. 0-6) Prerequisite: PHC 631.* Staff

641 Pharmaceutical Formulations *I, 2-4*
Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. *(Lec. 2, Lab. 3-6) Prerequisite: PHC 632.* Gerraughty and Gloor

642 Pharmaceutical Formulations *II, 2-5*
Methods of solving problems in pharmaceutical formulations to obtain therapeutically active, stable, and esthetically acceptable dose forms. *(Lec. 2, Lab. 3-9) Prerequisite: PHC 641.* Staff

697, 698 Research in Pharmacy *I and II, 1-3 each*
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy. *(Lab. TBA)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHARMACY ADMINISTRATION (PAD)

405 Pharmacy Personnel Administration *I, 2*

406 Pharmacy Retailing *II, 4*

451 Pharmacy Administration Principles *II, 3*

453 Drug Marketing Principles *II, 2*

497, 498 Special Problems *I and II, 1-3 each*

570 Case Studies in Pharmacy Law *II, 3*
Case studies and a detailed analysis of the FDC, Harrison narcotic, hazardous substances, poisons and public health insurance laws. *(Lec. 3) Prerequisite: PAD 351.* Staff

580 Prepaid Drug Plans *1, 3*
Institutional relationships involved in the prescribing, dispensing and prepayment of drugs. Problems of interference with pharmaceutical or medical practice arising from different types of prepayment plans. Actual experience, laws and court decisions, abuse and controls. *(Lec. 3) Prerequisite: PAD 451 and 453.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

621, 622 Seminar *I and II, 1 each*
Seminar discussions and presentation of papers on selected topics in pharmacy administration. *(Lec. 1) Students attend seminar each semester while in graduate residence, but a maximum of 1 credit per year is allowed. Not more than 3 credits are allowed for the entire period of residence.* Staff

651, 652 Health Care Systems I and II
I and II, 3 each
Arrangements for utilizing pharmaceutical resources in public and private systems of health care in the U.S. and other countries. Variations in quality and distribution of care among socio-economic groups. *(Lec. 3) Prerequisite: PAD 580 and BST 501 or equivalent.* Staff

697, 698 Research in Pharmacy Administration
I and II, 1-3 each
Literature survey, laboratory work and a detailed research report on one or more assigned topics in pharmacy administration. *(Lab. TBA)* Staff

PHILOSOPHY (PHL)

401, 402 Special Problems *I and II, 3 each*

405 Aesthetics *I or II, 3*

440 Philosophy of Language *I or II, 3*

441 Metaphysics *I or II, 3*

442 Epistemology *I or II, 3*

502, 503, 504, 505 Tutorial in Philosophy
I and II, 3 each
Discussion by the staff and advanced students of research problems in philosophy. Presentation and criticism of original papers. *(Lec. 3)* Staff

512 Seminar in Ethics and Value Theory *I or II, 3*
Intensive studies of various issues, theories and aspects in the field of values and valuation. The texts of leading moralists will be carefully analyzed. *(Lec. 3) In alternate years.* Staff

530 The Philosophy of Plato *I or II, 3*
Selected dialogues from the later period. Particular attention will be given to the areas of metaphysics, epistemology, cosmology, and ethics. *(Lec. 3) In alternate years.* Staff

531 Philosophy of Aristotle *I or II, 3*
Selected texts with emphasis on the major concepts of Aristotle's metaphysics, theory of knowledge, and ethics. *(Lec. 3) In alternate years.* Staff

540 Philosophy of Augustine *I or II, 3*
Examination of the philosophical background of Augustine's thought and of his doctrines of knowledge and reality with reference to his influence on the subsequent philosophical development in medieval and modern thought. *(Lec. 3) In alternate years.* Staff

541 Philosophy of Aquinas *I or II, 3*
Critical examination of the major contribution of Aquinas to metaphysics, epistemology, and philosophical psychology. *(Lec. 3) In alternate years.* Staff

551 Philosophical Logic *I or II, 3*
Intensive consideration of such issues as the nature, structure and function of propositions, predication and the analysis of the "is" relation. The relation between propositions and facts. The nature of logic and the criterion of the logical and the relation of logic to language, psychology and ontology. *(Lec. 3) In alternate years.* Staff

552 The Philosophy of Science *I or II, 3*
An inquiry into the nature and history of scientific thought, with emphasis on the analysis of fundamental concepts of the physical and biological sciences in the order of human knowledge and on their importance for human existence. *(Lec. 3) Prerequisite: PHL 101 and a year of either physical or biological science or permission of instructor.* Staff

560 British Empiricists *I or II, 3*
Intensive analysis of the work of one or more of the British empiricists: Locke, Berkeley, or Hume. *(Lec. 3) In alternate years.* Staff

561 Continental Rationalists *I or II, 3*
Intensive analysis of the work of one or more of the continental rationalists: Descartes, Spinoza or Leibniz. *(Lec. 3) In alternate years.* Staff

570 Philosophy of Immanuel Kant *I or II, 3*
Intensive analysis of major texts. Special attention will be given to *The Critique of Pure Reason. (Lec. 3) In alternate years.* Staff

580 Nineteenth-Century Philosophy *I or II, 3*
Intensive analysis of the work of a major philosopher or philosophical movement. Attention will be given to

such major figures as Hegel, Kierkegaard, C. S. Peirce, or James. The specific subject changes from year to year. *(Lec. 3) In alternate years.* Staff

581 Twentieth-Century Anglo-American Philosophy *I or II, 3*
Intensive analysis of the work of one contemporary British or American philosopher or philosophical movement. The specific subject changes from year to year. *(Lec. 3) In alternate years.* Staff

590 Contemporary European Philosophy *I or II, 3*
Intensive analysis of the works of selected representatives of such schools as neo-Kantianism, phenomenology, neo-positivism, neo-Hegelianism, historicism, and vitalism. *(Lec. 3) In alternate years.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHYSICAL EDUCATION (PED)

510 Current Problems in Physical Education, Health and Recreation *I, 3*
Current problems in physical education, health, and recreation designed to acquaint the students with conditions that give rise to problems and various techniques used in finding solutions to them. *(Lec. 3) Prerequisite: permission of department.* Staff

520 Curriculum Construction in Physical Education *II, 3*
Analysis of criteria and procedures for curriculum construction in physical education. Standards for the evaluation and revision of elementary and secondary school physical education courses. *(Lec. 3) Prerequisite: permission of department.* Staff

530 Research Methods and Design in Health and Physical Education *I, 3*
Introduction to methodology in experimental, laboratory, curriculum, action, and historical research. *(Lec. 3) Prerequisite: competence in basic statistics and permission of department.* Sonstroem

540 Principles of Recreation Leadership *II, 3*
Modern concepts of responsibilities involved in program planning in schools and community agencies. Leadership of committees and board relations as well as practical program promotional techniques. *(Lec. 3) Prerequisite: permission of department.* Leathers

550 Administration of Physical Education *II, 3*
Problems and procedures for administering a physical education program studied from the viewpoint of the physical education administrator, the school administrator and the faculty. Emphasis is placed upon the study of administrative cases. *(Lec. 3) Prerequisite: PEM 380.* Nedwidek and Polidoro

560 Seminar in Health, Physical Education and Recreation *I, 3*
Selected topics within the three areas, depending on availability of specialized instruction including visiting professorships. *(Lec. 3) Prerequisite: permission of department.* Staff

570 Major Health Problems and Curriculum Planning in Health Education *II, 3*
Major health problems related to personal and community health with emphasis on health education, curriculum planning and evaluation. *(Lec. 3) Prerequisite: permission of department.* DelSanto

575 Perceptual-motor Education *I, 3*
The role of motor activity in enhancing perceptual development and how the physical educator can become involved in cooperation with other school personnel in the implementation and continuing development of perceptual-motor programs. For teachers in elementary schools and in special education who wish to incorporate motor activities into their programs. *(Lec. 3) Prerequisite: PSY 113, 232 and permission of instructor.* McCormick

580 Physical Education for the Mentally Retarded *I, 3*
Introduction to the contributions of physical education to the growth and development of mentally retarded. Basic movement, rhythms, games, sports, stunts, tumbling, gymnastics, apparatus, etc. for both educable and trainable mentally retarded. *(Lec. 3) Prerequisite: PSY 442 and/or permission of department.* McCormick

581 Psychological Aspects of Physical Activity *II, 3*
Scientific principles and research from psychology are studied and related to physical activity. Educational program situations amenable to research and the application of psychological principles are isolated. Major emphasis is utilized to recommend improvements in physical education methodology. *(Lec. 3) Prerequisite: PSY 113, 232 and permission of instructor.* Sonstroem

585 Physical Education for the Atypical Child *I, 3*
Limitations, needs, learning characteristics of the physically and mentally handicapped child which apply to verbal response, body control, kinethesis and neuromuscular acceptance. Research reviewed and synthesized for a practical problem. *(Lec. 3) Prerequisite: ZOO 121, 142, and kinesiology recommended.* Slader

591 Special Problems *I or II, 3*
Requirements are satisfied by writing a paper reporting the in-depth investigation of a pertinent problem in the field, including a review of relevant literature, analysis and solution of the problem based on scientific methodology, and recommendations for improved practices. *Limited to and required of all master's degree candidates in physical education who elect the non-thesis option.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PHYSICAL EDUCATION FOR MEN (PEM)

410 Adaptive and Corrective Physical Education *I, 3*

PHYSICAL EDUCATION FOR WOMEN (PEW)

410 Corrective and Adaptive Physical Education *I, 3*

495 Directed Study *I and II, 3*

PHYSICS (PHY)

401, 402 Seminar in Physics *I and II, 1 each*

406 Introduction to Atmospheric Physics *I, 3*

420 Introduction to Thermodynamics and Statistical Mechanics *I, 3*

421 Introduction to Theoretical Physics *I, 3*

425 Acoustics *I, 3*

431 Introduction to Theoretical Physics *II, 3*

451 Atomic and Nuclear Physics *I, 3*

452 Nuclear Physics *II, 3*

455 Introduction to Solid State Physics *II, 3*

483, 484 Laboratory and Research Problems in Physics *I and II, 3 each*

491, 492 Special Problems *I and II, 1-6 each*

510, 511 Mathematical Methods of Physics *I and II, 3 each*
Definition of a vector, vector algebra and calculus, scalar and vector fields, linear vector operators, coordinate transformations, vector operations in curvilinear coordinates, dyadics, tensors, simple applications of the theory of finite groups. Partial differential equations of physics and their solutions; diffusion equation, wave equation, Schrodinger equation, Klein-Gordon equation, elements of the theory of probability. *(Lec. 3) Prerequisite: permission of department.* Hartt

520 Classical Dynamical Theory I *I, 3*
Lagrange's equations, holonomic and non-holonomic constraints, applications to dynamical systems, non-inertial systems, alternate formulations of mechanics, theory of small vibrations, variational principles, Hamiltonian formulation of dynamics, canonical transformations. *(Lec. 3) Prerequisite: PHY 421, 510.* Staff

521 Classical Dynamical Theory II *II, 3*
Poisson's brackets, infinitesimal contact transformations, Hamilton-Jacobi equation, action-angle variables, transition to quantum mechanics, special problems in dynamics. *(Lec. 3) Prerequisite: PHY 520.* Staff

522 Topics in the Physics of the Earth *II, 3*
Physics of the earth. Topics chosen from: elasticity, seismology, and the structure of the earth; terrestrial electricity, gravity, heat flow, magnetism, radioactivity, and tides; physics of the upper atmosphere. *(Lec. 3) Prerequisite: permission of department. In alternate years, next offered 1971-72.* Dietz

530 Electromagnetic Theory I *I, 3*
Coulomb's law, Gauss' law, scalar potential, boundary value problems, multipole expansion, dielectrics, magnetic field due to stationary currents, scalar and vector potential, magnetic materials, Faraday's law, Lorentz force, conservation laws, Maxwell's equations. *(Lec. 3) Prerequisite: PHY 431, 510.* Staff

531 Electromagnetic Theory II *I, 3*
Scalar and vector wave equations and their solutions, retarded and advanced potentials, Lienard-Wiechert potentials, radiation from an arbitrarily moving charge, multipole radiation, wave guides, cavity resonators, plasma oscillations, theory of relativity. *(Lec. 3) Prerequisite: PHY 511, 530.* Staff

550 Physical Acoustics *I, 3*
Physical properties of gases, liquids and solids as revealed by the propagation of acoustic waves. Ultrasonic generation and measurement techniques, irreversible thermodynamics, mechanisms for absorption and dispersion of acoustic waves. *(Lec. 3) Prerequisite: permission of department.* Letcher

570 Quantum Mechanics I *I, 3*
Wave packets, Schrodinger equation, one-dimensional problems, hydrogen atom, harmonic oscillator, WKS approximation, operator formalism and matrix mechanics, angular momentum, perturbation theory, scattering and partial wave analysis, semiclassical treatment of the radiation field. *(Lec. 3) Prerequisite: permission of department.* Staff

571 Quantum Mechanics II *II, 3*
Dirac equation, spin orbit energy, theory of positrons, Feynman diagrams, Compton scattering, pair production and bremsstrahlung. Second quantization and application to selected topics. *(Lec. 3) Prerequisite: PHY 570.* Staff

580 Graduate Laboratory *I and II, 3*
Laboratory experiments designed to be performed by beginning graduate students. The laboratory will consist of a limited number of classic experiments to be

completed with precision and thoroughness. Experiments will be selected primarily from the areas of atomic, nuclear and solid state physics. *(Lab. 6) Prerequisite: permission of department.* Quirk

585 Acoustic Measurements *II, 1-2*
Techniques for the measurement and analysis of sound in fluids and solids. *(Lab. 3-6) Prerequisite: permission of department.* Staff

590, 591 Special Problems *I and II, 1-6 each*
Advanced work under the supervision of a member of the staff and arranged to suit the individual requirements of the student. *(Lec. or Lab. according to nature of problem) Credits not to exceed 12. Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

620 Statistical Mechanics *I and II, 3*
Kinetic theory of matter, Maxwell-Boltzmann distribution, collision and mean free path, the H-theorem, Ergodic theorem, entropy, Nernst heat theorem, fluctuations and distributions, quantum statistics, ensemble theory, applications in nuclear physics, fluidity, condensation, electron theory of metals and relativistic gas. *(Lec. 3) Prerequisite: PHY 511, 570.* Staff

630 Electromagnetic Theory III *I, 3*
After developing the covariant formulation of electrodynamics, selected topics of current interest in electromagnetic theory such as accelerator design, etc., will be discussed. *(Lec. 3) Prerequisite: PHY 531.* Staff

650, 651 Solid State Physics *I and II, 3 each*
Quantum theory of electrons, phonons and other elementary excitations, Hartree-Fock approximation, many body problem, super conductivity, band theory and Fermi surface. *(Lec. 3) Prerequisite: PHY 455, 570.* Staff

660, 661 Nuclear Physics *I and II, 3 each*
General properties of the nucleus. Two body problem at low, intermediate and high energy. Three and four body problems, nuclear forces, special models, nuclear spectroscopy and reactions, decay of nuclei, many body problem, structure of nucleons. *(Lec. 3) Prerequisite: PHY 511, 571.* Staff

670, 671 Advanced Quantum Theory *I and II, 3 each*
Relativistic quantum field theory, free and interacting fields, the S-matrix and the perturbation expansion, quantum electrodynamics, dispersion relations, symmetry operations and invariance properties. *(Lec. 3) Prerequisite: PHY 571.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PLANT AND SOIL SCIENCE (PLS)

401, 402 (HOR 501, 502) Plant and Soil Science Seminar *I and II, 1 each*

405 (HOR 305) Propagation of Plant Materials *II, 3*

420 (AGR 420) Crop Ecology *I, 3*

432 (HOR 432) Commercial Floriculture *II, 3*

442 (AGR 442) Professional Turfgrass Management *II, 3*

444 (HOR 444) Environmental Aspects of Landscape Design *II, 3*

451 (MAG 451) Soil Conservation Technology *I, 3*

454 (HOR 354) Identification of Basic Ornamental Plants *II, 3*

461 (AGR 561) Weed Science *II, 3*

470 (AGR 472) Soil Fertility *II, 3*

472 (HOR 472) Plant Improvement *II, 3*

475 (HOR 475) Plant Nutrition *I, 3*

484 (MAG 384) Structures *II, 3*

491, 492 (HOR 491, 492) Special Projects and Independent Study *I and II, 1-3*

500 (HOR 500) Growth and Development of Economic Plants *II, 3*
Factors affecting vegetative and reproductive growth and development of plants. Topics include growth regulators, auxins, environmental factors, dormancy, juvenility, vernalization and flowering. Term paper required. *(Lec. 3) Prerequisite: BOT 442. In alternate years, next offered 1972-73.* Shutak

501, 502 (AGR 501, 502) Graduate Seminar in Plant and Soil Science *I and II, 1 each*
Presentation of technical reports and discussion of current research papers concerned with plant and soil science. *(Lec. 1)* Staff

573 (HOR 573) Post-harvest Physiology of Economic Crops *I, 3*
Factors affecting post-harvest physiology of fruits, vegetables, flowers, ornamentals and turf. Influence of preharvest factors on post-harvest condition. Principles of preservation and storage. Individual or group projects. *(Lec. 3) Prerequisite: BOT 442 or equivalent. In alternate years, next offered 1972-73.* Shutak and Staff

576 (HOR 576) Physiology of Plant Productivity *II, 3*
Critical analysis of contemporary views on energy

conversion and transformation in primary plant production. Topics include photosynthesis, phosphorylation, photorespiration, transport mechanisms, carbohydrate and lipid metabolism, nitrogen assimilation and symbiosis. *(Lec. 3) Prerequisite: organic chemistry, plant physiology, biochemistry recommended. In alternate years, next offered 1971-72.* Hull

591, 592 (AGR 591, 592) Non-thesis Research in Plant and Soil Science *I and II, 1-3*
Advanced work under supervision of research staff to expand research experience into areas other than those related to thesis research. Arranged to suit individual requirements. *(Lab. 3-9) Prerequisite: permission of department.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PLANT PATHOLOGY-ENTOMOLOGY (PLP)

442 (342) Diseases of Turfgrasses, Trees and Ornamental Shrubs *II, 3*

561 Plant Virology *I, 3*
Nature and properties of plant viruses, survey of plant diseases caused by viruses and experience in basic techniques. *(Lec. 3) Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1971-72.* Mueller

582 Nematology *II, 3*
Morphology, taxonomy, bionomics and physiology of plant parasitic, soil, and aquatic nematodes. Emphasis on host-parasite relationships, laboratory techniques, and principles of control. *(Lec. 2, Lab. 2) Prerequisite: ZOO 111, BOT 332. In alternate years, next offered 1972-73.* Stessel

591, 592 Research Problems *I and II, 1-3 each*
Individual or group study supervised by a faculty member in the fields of plant virology, nematology and disease mechanisms, economic entomology or plant pathology, agricultural and industrial mycology and related subjects. Written reports required for credit. *(Lec. 1-3, Lab. 2-6)* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

611 The Nature of Plant Disease *I, 3*
Analysis of the nature of plant disease, the concepts of infection and pathogenesis, and the interaction of plant, pathogen, and environment in the disease process. *(Lec. 3) Prerequisite: BOT 332 or equivalent. In alternate years, next offered 1972-73.* Beckman and Mueller

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Note: For other related courses see BOT 332, 432, 434 and ZOO 481, 482, 581, 586.

POLITICAL SCIENCE (PSC)

402 Government and Politics in the Middle East *I, 3*

403 Government and Society of India and Pakistan *I, 3*

404 Government and Politics of South East Asia *I, 3*

407 The Soviet Union: Politics and Society *II, 3*

408 African Governments and Politics *I, 3*

411 The United States and China *II, 3*

417 African Ideologies and International Relations *II, 3*

420 Radical Change in the Modern Era *II, 3*

422 State and Local Government *II, 3*

431 International Relations *I, 3*

432 International Government *II, 3*

434 American Foreign Policy *II, 3*

443 Twentieth-Century Political Theory *I, 3*

454 Advanced Political Research *II, 3*

456 Directed Study or Research *I and II, 3*

460 Urban Politics *I, 3*

461 The American Presidency *II, 3*

462 American Constitutional Law *I, 3*

463 American Civil Liberties *II, 3*

464 International Law *II, 3*

470 Problems and Principles in the American Political Process *II, 3*

472 Problems in International Relations *I, 3*

481, 482 Political Science Seminar *I and II, 3 each*

484 The Middle East in World Affairs *II, 3*

491 Principles of Public Administration *I, 3*

498 Public Administration and Policy Formulation *II, 3*

501 Administrative Theory *I and II, 3*
Various theoretical constructs and models in the field of public administration, in particular the theories of Weber, Riggs, Dorsey, Simon, Presthus, as well as lower-level models in subfields of organization, communications, and decision-making. Students relate task-oriented subject matter such as personnel administration, budget administration and program administration to the theoretical formulations which seek to explain these activities. *(Lec. 3) Prerequisite: PSC 491 or permission of department.* Grossbard

502 Techniques of Public Management *I and II, 3*
Principles, methods and techniques employed in the technical administration of the staff activities of the public service such as administrative planning, personnel management, and fiscal administration. Project programming, personnel classification and design of pay plans, budgeting, and fiscal management. *(Lec. 3) Prerequisite: PSC 491 or permission of department.* Grossbard

505 Politics of Developing Areas *II, 3*
Analysis of developments in newly independent, "third world" nations, particularly of Asia. Emerging political structures in relation to the processes of social, economic, and psychological change. *(Lec. 3) In alternate years, next offered 1973-74.* Stein

506 The U.S.S.R. and China in World Affairs *I, 3*
Comparative study of the foreign policies of the Communist nations. Examines continuity and change of Soviet policy in historic perspective, competitive coexistence with the West in the post-Stalin era, China's outlook on the world, the Sino-Soviet dispute, policy toward developing areas, international organization and arms control. *(Lec. 3) Prerequisite: PSC 407 or permission of instructor.* Stein

513 Seminar in Marine Science Policy and Public Law *II, 3*
Multi-disciplinary teams of faculty and selected graduate students tackle unresolved problems in creating rules or institutions to cope with new uses of the marine environment, e.g., freedom of the seas, fisheries regulation, deep-sea mining, or weather modification. Team meetings at team convenience; plenary sessions; backup studies for team meetings plus final report. *Prerequisite: permission of department.* Staff

523 Seminar in Comparative and International Public Administration *I and II, 3*
Selected areas of the theory, practice, organization and operation of the English and French administrative systems and their influence on the newly established countries. Administration of international agencies such as I.L.O., W.H.O. and the administrative problems of headquarters and field. Use of models, structure-function analysis and ecological analyses. *(Lec. 3) Prerequisite: PSC 491, 501 or permission of department.* Staff

524 Seminar in Problems of Public Administration *I and II, 3*
Exploration in depth of selected problems of policy formation, and basic research in public administration, and the application of research to administration situations. Students apply the techniques of science and administration to a single problem or set of problems, designated for each seminar. Reports, embodying the results of conceptual exercises, experimentation, library research and field investigations, are required. *(Lec. 3) Prerequisite: PSC 491, 501, 502, or permission of department.* Staff

544 Democracy and Its Critics *I, 3*
Seminar examining the roots of modern democracy in the social contract theorists and analyzing the quality and limits of self-determination in these theories in the light of contemporary politics. *(Lec. 3) Prerequisite: PSC 341, 342, or permission of department.* Killilea

553 Scope and Methods of Political Science *I, 3*
Development of political science in relation to other social sciences. Political concepts, theories, and analytic systems surveyed in relation to methodology. Latest trends and interests in the discipline. Research papers and reports explore individual problems. Required for graduate students. *(Lec. 3)* Sack

556 Directed Study or Research *I and II, 3*
Special work arranged to meet the individual needs of graduate students in political science. *(Lec. 3) Prerequisite: permission of department.* Staff

565 Seminar in Political Processes *II, 3*
Advanced study involving special investigations of the American political process. Analysis and application of methodology in such areas as voting behavior, interest group activities, and the legislative process. Use of case study techniques. *(Lec. 3) Prerequisite: PSC 365 or permission of department.* Zucker

566 American Political Theory *II, 3*
Examination of origins and development of American political thought, with reference to the European backgrounds and an intensive study of the political ideas of representative American thinkers. *(Lec. 3) Prerequisite: PSC 113. In alternate years, next offered 1971-72.* Staff

567 American Jurisprudence *II, 3*
An introduction, from the perspective of contemporary political science, to the philosophy of law, treating the sources, the nature, and the consequences for American life and law of major systems of legal

thought. Emphasis on the relationship between legal reasoning and the results of the judicial process. *(Lec. 3) Prerequisite: one course in business law or constitutional law. In alternate years, next offered 1971-72.* Wood

573 Advanced Research in Political Science *II, 3*
Fundamental concepts and techniques in political science with emphasis on advanced quantitative and qualitative analysis and the application of these methods to individual research projects. *(Lec. 3) Prerequisite: PSC 553 or permission of department.* Staff

590 Internship in Public Administration *I and II, 3-6*
Participation in the activities of an administrative agency under the joint supervision of the agency head and a member of the faculty gives the student direct knowledge of such fields as planning, personnel management, research organization, budgeting, interdepartmental relations, and the informal liaisons that are the hallmark of effective administration. *May be taken as one 6-credit unit or two 3-credit units. Prerequisite: permission of Bureau of Government Research.* Staff

595 Problems of Modernization in Developing Nations
See Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

PORTUGUESE (POR)

497, 498 Directed Study *I and II, 3 each*

PSYCHOLOGY (PSY)

410 Quantitative Methods in Psychology II *I and II, 3*

432 Advanced Development Psychology *II, 3*

434 Introduction to Psychological Testing *I and II, 3*

435 The Psychology of Social Behavior *I and II, 3*

445 Group Processes and Individual Behavior *I and II, 3*

452 Aging and the Individual *II, 3*

460 The Psychology of Violence and Aggression *I and II, 3*

461 Social and Psychological Aspects of Alcoholism *I and II, 3*

463 Psychology of Personal Meaning *I and II, 3*

479 Contemporary Problems for Modern Psychology *II, 3*

489, 499 Problems in Psychology *I and II, 3 each*

510 Intermediate Quantitative Methods *I, 3*
Complex statistical techniques useful in practical psychological research including analysis of variance and co-variance, multiple correlation, regression analysis, and introductory multivariate analysis methods. *(Lec. 2, Lab. 2)* Merenda and Cain

520 Psychometric Methods *I and II, 3*
Techniques for investigating the areas of attitude and opinion research, morale and leadership, personality and perception. Includes scalogram analysis, attitude scales and "Q" techniques. *(Lec. 3) Prerequisite: PSY 434.* Staff

530 Seminar in Phenomenology and Psychology *I and II, 3*
Phenomenology as a method of psychological study. Emphasis upon current relationship between phenomenology and contemporary psychological issues—cognition, behaviorism, psychoanalysis. Special areas of interest (e.g., emotions, interpersonal relations, values) will be subjected to a phenomenological analysis. *Prerequisite: PHL 101 and permission of department.* Staff

534 Clinical Interpretation of Standardized Psychological Tests *II, 3*
Test profile integration and pattern analysis. Practice given in the critique of personal evaluation reports based on standardized test results, and the preparation of such reports. Standardized psychological group tests discussed in relation to interpretation of the test profiles and protocols. *(Lec. 3) Prerequisite: PSY 434 and permission of department.* Staff

542 The Exceptional Child *I and II, 3*
Definition and proper classification of types of exceptional children, and the social, psychological, and physical factors involved. Problems of rehabilitation and psychological treatment of the exceptional child. Types of exceptional children such as superior, retarded, physically handicapped, and those suffering from developmental aberrations. *(Lec. 3) Prerequisite: PSY 232, 254 and permission of department.* Staff

550 (or PCL 550) Operant Analysis of Behavior *I, 3*
Introduction to the principles of operant conditioning with emphasis on the use of these principles in the analysis of behavior. *(Lec. 3) Prerequisite: permission of department.* Lal and Smith

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

600 Advanced General Psychology *I or II, 1-15*
A series of courses that provide incoming graduate

students with intensive preparation in the major areas of general psychology: a) psychophysiology, b) sensation and perception, c) learning, d) cognition, e) social behavior, f) development of behavior, g) personality, h) psychopathology. During their first year, students take one credit in each area in which they have no previous graduate training. *(Lec. 1) Prerequisite: permission of department. Students who have taken PSY 305 may not take 600 a or b; students who have taken PSY 306 may not take 600 c or d.* Staff

610 (or EST 610) Factor Analysis *II, 3*
Study of and comparison among various procedures of factor analysis including tetrad differences, bi-factor, group centroid, principal components and canonical methods. Interpretation of factors. Estimation of factor loadings and specific variances. Methods for factor rotation. Estimation of factor scores. *(Lec. 3) Prerequisite: EST 541.* Merenda

611 Methods of Psychological Research and Experimental Design *I and II, 3*
Provides the student of psychology with a knowledge of research methodology and the techniques of experimental designs. It prepares for the development of thesis problems of graduate students in psychology and related disciplines. *(Lec. 3) Prerequisite: PSY 510.* Merenda

615 Seminar: Advanced History and Systems of Psychology *I and II, 3*
Intensive and critical consideration of major problems in the strategies of data collection, interpretation and theory construction. Particular attention to the historical roots of these problems and the criteria of empirical adequacy. *(Lec. 3) Prerequisite: PSY 301, 310. Not offered 1971-72.* Staff

616 Methodology and Design in Research in School Psychology *I and II, 3*
Models of research design and methodology particularly applicable to the school situation are explored. *(Lec. 3) Prerequisite: PSY 434, 510, 611, and permission of department.* Staff

617 Methodology and Design in Research in Clinical Psychology *I and II, 3*
Models of research design and methodology particularly pertinent to the area of clinical psychology with emphasis on mental designs appropriate to research problems, using specific experiments and original research. *(Lec. 3) Prerequisite: PSY 434, 510, 611, and permission of department.* Staff

620 Seminar: Classical Conditioning *I and II, 3*
History and nature of the conditional reflex, with emphasis placed on understanding the role of the conditional reflex and contemporary behavioral research and theory. *(Lec. 3) Prerequisite: permission of department. Not offered 1971-72.* Staff

621 Seminar: Human Learning and Memory *I and II, 3*
Experimental analysis of major problem topics of learning and retention studies in humans. Emphasis on systematic studies of verbal habits, dimensional analysis of the critical variables influencing these habits, and the interference theory of forgetting. *(Lec. 3) Prerequisite: permission of department. Alternate years.* Staff

640 Personality Dynamics I (Advanced Personality) *I, 3*
Readings from the original sources of the major contemporary personality theorists. Emphasis on the possible integration of these theories, and the development of syncretic theory according to individual preferences. *(Lec. 3) Prerequisite: PSY 235.* Staff

660 Personality Dynamics II (Advanced Psychopathology) *I and II, 3*
Study of empirical literature with regard to etiological factors involved in the formation of pathological character trends and deviations. Evaluation of clinical theory and classification systems as related to the psycho-therapeutic process. *(Lec. 3) Prerequisite: PSY 254, 640.* Staff

661 Psychological Services I (Administration and Interpretation of Cognitive Tests) *I, 3*
Instruction and practice in the administration and interpretation of cognitive tests; individual intelligence tests of both general and specific abilities. Seminar underlying rationale research evidence and clinical application of such tests as Stanford-Binet, Wechsler, Bender-Gestalt, Lister International. *Laboratory practicum. (Lec. 2, Lab. 2) Prerequisite: PSY 232, 235, 254, 434, and permission of department.* Staff

662 Psychological Services II (Administration and Interpretation of Personality Tests) *II, 3*
Instruction and practice in the administration and interpretation of instruments used in the assessment of personality. Emphasis upon projective tests such as Rorschach, TAT. Seminar underlying rationale, research evidence and clinical application. *(Lec. 2, Lab. 2) Prerequisite: PSY 661 and permission of department.* Staff

663 Seminar to Accompany Field Experience in Psychological Services *I and II, 3*
All students meet in seminar to discuss and investigate specific diagnostic, therapeutic, research problems emerging in connection with internship experience. *(Lec. 3) Prerequisite: PSY 670.* Staff

664 Advanced Diagnostic Problems *I and II, 3*
Use and interpretation of cognitive, projective, and neural psychological tests. Focus on integrated data into meaningful description of total personality functioning. Use of the diagnostic interviewer. *(Lec. 3) Prerequisite: PSY 640, 660, 661, 662 and permission of instructor.* Berman

665 Seminar: Behavior Disorders in Childhood *I and II, 3*
Emphasis on etiological factors, diagnostic and treatment consideration, and experimental research findings related to the psychological maladjustments in infancy and childhood; treatment procedures, resources and methods used in dealing with behavior and personality problems. Lectures, discussions, and case demonstrations. *(Lec. 3) Prerequisite: PSY 660.* Silverman and Staff

666 Seminar: The Professional Psychologist in the Community *I and II, 0*
Ethical and professional standards related to the practice of psychological services. Discussion and guest lectures by members of related disciplines. Special emphasis upon the role of the professional psychologist in the community. *(Lec. 1) Prerequisite: permission of department.* Staff

670 Field Experience in Psychological Services Internship *I and II, 6-12*
Internships for advanced graduate students are available in a variety of institutional, agency and school settings under supervision which must be acceptable to the department. *(TBA) Prerequisite: equivalent of 1 year full-time graduate work, psychological service sequence, permission of department.* Staff

671 Clinical Practices I (Diagnostic) *I and II, 3*
Supervised practice in the assessment of problem behavior. Emphasis on the integration of data from psychological tests, case histories, and other sources in the assessment of personality. Practicum facilities available in several agencies. *(Lec. 2, Lab. 2) Prerequisite: PSY 661, 662, and permission of department.* Staff

672 Individual Clinical Practicum *I and II, 3-6*
Introductory experience in dealing with clinical problems in a variety of clinical settings. Individual supervision to be arranged. *(Lec. 2, Lab. 2) Prerequisite: PSY 661, 662, and permission of department.* Staff

673 Seminar: Introduction to Clinical Psychotherapy *I and II, 3*
Theories and techniques of psychotherapeutic procedures involving directive and nondirective and play therapies. Theoretical rationale and empirical research with special emphasis on the child area. *(Lec. 3) Prerequisite: permission of department.* Staff

674 Clinical Practices II (Therapy) *I and II, 3*
Specialized practices and techniques of clinical interviewing, counseling, and psychotherapy with children and adults. Observations, readings, and model tapes supplement critical discussion of the student's own supervised therapy sessions. *(Lec. 2, Lab. 2) Prerequisite: PSY 640, 660, 673, and permission of department.* Staff

675 Experimental Psychopathology *I and II, 3*
Relates recent experimental methodology and findings to prevalent theoretical positions. Emphasis on reviewing experimental literature in specialized clinical areas. *(Lec. 3) Prerequisite: PSY 510, 611, and permission of department. Alternate years.* Staff

676 Neurological Correlates of Psychopathology *I and II, 3*
Functioning and physiology of central nervous system with particular attention to determining how neurological disruption and injury are manifested in behavioral disorder. Techniques used to evaluate and interpret neuropsychological functioning. *(Lec. 3) Prerequisite: permission of instructor. Alternate years.* Berman

680 School Practices I (Diagnostic) *I and II, 3*
Testing procedures and devices in the diagnosis of organicity, personality problems, special learning problems, visual, auditory, and memory problems; includes administration, interpretation, and special adaptation of tests in the school situation. *(Lec. 2, Lab. 2) Prerequisite: PSY 434, 661, 662, and permission of department.* Staff

681 Special Problems in School Psychology *I and II, 3-6*
The role of the psychologist in the school setting. Several theoretical and practical issues concerned with the value of psychological theory, administrative philosophy, and school organization are explored. *(Lec. 2, Lab. 2) Prerequisite: PSY 680 and permission of department.* Staff

682 Individual Practicum in School Psychology *I and II, 3-6*
Designed to accompany the student's internship in the school setting. Techniques for adapting psychological services to function within the school system. Individual supervision to be arranged. *(Lec. 2, Lab. 2) Prerequisite: permission of department.* Staff

683 Psychology of the Exceptional Child *I, 3*
Social, psychological and educational factors that constitute the matrix of concerns with the exceptional individual in the school and community. Attention given to recent innovations in public and private education and habilitation. Research issues and legislation discussed will evolve into student studies. *(Lec. 3) Prerequisite: permission of department.* Gross

684 Learning Disabilities *I, 3*
Introduction to developments in the field of disorders of learning in the school-age child, stressing recent conceptualizations of underlying psychological parameters essential to basic processes involved in learning. Interdisciplinary approaches to diagnosis discussed and the innovation of precriptive teaching introduced. *(Lec. 3) Prerequisite: PSY 683 and/or permission of instructor. Alternate years.* Gross

685 Psychology of Mental Retardation *II, 3*
Etiological factors, including biogenetic, physiological

and social origins of mental retardation. The epidemiology and ecological aspects considered as they interact with social and cultural forces. Historical and current philosophy of habilitation and education of school-age children and adults. *(Lec. 3) Prerequisite: PSY 683 and/or permission of instructor.* Gross

686 Psychology and Education of the Emotionally Disturbed *II, 3*
Current thinking on treatment and education of residential and day-care programs for the emotionally disturbed. Meaning of the various concepts of schizophrenia, autism and hyperkinetic impulse disorder for treatment. Application of operant techniques for shaping socially appropriate behavior. Overview of origins of current operant methods in hospitals and schools. *(Lec. 3) Prerequisite: PSY 683 and/or permission of instructor. Alternate years.* Gross

690 Seminar: Contemporary Issues in Psychology *I and II, 3-12*
Recent developments and current issues. Rigorous exploration of experimental and theoretical literature. Study limited each semester to one of the following areas: developmental, clinical, motivation, perception, psychophysics, and scaling problem solving and thinking. *A maximum of 4 seminars may be taken. (Lec. 3) Prerequisite: permission of department. Alternate years.* Staff

691 Individual Practicum in Teaching Psychology *I and II, 1-6*
Supervised experience in the teaching of psychology at the undergraduate level. Students will be involved in laboratory and discussion groups under didactic supervision of a faculty teaching committee. 1 credit per semester. *(Lab. 2) Prerequisite: permission of department.* Staff

692, 693 Directed Readings and Research Problems *I and II, 3 each*
Directed readings and advanced research work under the supervision of a member of the staff arranged to suit the individual requirements of the students. May be taken for up to 6 credits. *Prerequisite: permission of department.* Staff

694 Special Problems in Clinical Psychology *I and II, 3*
Instruction and clinical practicum training in unique problem areas of clinical psychology. Development of specialized evaluation instruments and procedures. *(Lec. 2, Lab. 2) Prerequisite: PSY 661, 662, and permission of department.* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

RESOURCE ECONOMICS (REN)

441 Economics of Food Marketing *I, 3*

442 Advanced Food Marketing *II, 3*

450 Resource Policy and the Environment *II, 3*

491, 492 Special Projects *I and II, 3 each*

514 Economics of Marine Resources *I, 3*
The role of economics in development of marine resources. Particular attention to problems of multiple use of resources and to the conflicts between private and public goals. *(Lec. 3) Prerequisite: MMA students or permission of instructor.* Rorholm

527 Macroeconomic Models
See Economics 527.

528 Microeconomic Models
See Economics 528.

531 Land Economics
See Community Planning 531.

534 Economics of Resource Development I *II, 3*
Economic theory applied to the development of human and natural resources with topics drawn from current resource use problems. Analytical techniques treated are simulation techniques, cost-benefit analysis, input-output models, growth models, Cobb-Douglas functions, and Markov chains. *(Lec. 3) Prerequisite: REN 531 and EST 412 or equivalent, or permission of instructor.* Gates

543 Economic Structure of the Fishing Industry *I, 3*
Analysis of U.S. and world fishing industries from standpoint of activity and efficiency. Problems related to common property resources, government policy, labor, and legal and institutional factors will be covered. *(Lec. 3) Prerequisite: ECN 427 and 428 or permission of instructor.* Holmsen

576 (or EST 576) Econometrics I *I, 3*
Application of statistics and mathematics to economic analysis. The implications of assumptions required by statistical methods for testing economic hypotheses will be fully explored. Current research applications of econometric methods examined and discussed. *(Lec. 3) Prerequisite: REN 528 and EST 412 or equivalent.* Lampe

577 (or EST 577) Econometrics II *II, 3*
Continuation of Econometrics I. *(Lec. 3) Prerequisite: REN 576.* Lampe

595 Problems of Modernization in Developing Nations
See Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

602 Research Methodology *I and II, 3*
Evaluation of alternative research methods and tech-

niques. Development of specific research projects. *(Lec. 3)* Staff

610 Advanced Studies *I and II, 3*
Advanced topics in resource economics. Mathematical models in resource management. May be repeated for different topics. *(Lec. 3)* Staff

634 Economics of Resource Development II *II, 3*
Concepts of economic efficiency applied to natural resources with emphasis on marine resources. Application of welfare and institutional economics to resource development; analysis of optimum allocation among users. *(Lec. 3) Prerequisite: REN 534 and ECN 428.* Mattox

635 Marine Resources Policy *II, 3*
Analysis of public policy problems relating to the development and management of marine resources, including fisheries, minerals, petroleum, water and recreation. *(Lec. 3) Prerequisite: REN 534, ECN 427 and 428.* Norton

675 Mathematical Economics *II, 3*
Application of mathematical tools to problems in micro- and macroeconomics. Mathematical treatment of models of consumption, production, market equilibrium and aggregate growth. *Prerequisite: ECN 627 and 628.* Norton

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

RUSSIAN (RUS)

460, 461 The Russian Novel *I and II, 3 each*

901, 902 Graduate Reading Course in Russian *I and II, 0*
Two-semester course prepares the graduate student in other fields to use Russian to further research in his major field. Attention is given primarily to acquiring a reading knowledge with little emphasis on the spoken language. Assumes no prior knowledge of Russian. Staff

SOCIOLOGY (SOC)

408 Industrial Sociology *I, 3*

410 Complex Organizations in Modern Society *II, 3*

412 Occupations, Professions, and Social Structure *I and II, 3*

414 Demography *I and II, 3*

416 Seminar in Criminology *II, 3*

430 Social Pathology and Social Change *I, 3*

432 Ecology of the Community *I or II, 3*

434 Urban Sociology *I, 3*

436 Sociology of Politics *II, 3*

438 Aging and Society *I, 3*

440 The Sociology of Mental Illness *I and II, 3*

492 History of Sociological Thought *I, 3*

494 Theory and Methods of Sociology Research *I, 3*

496 Advanced Sociological Research *II, 3*

502 Contemporary Sociological Theory *II, 3*
Critical examination of the theories and systems of contemporary sociologists. *(Lec. 3) Prerequisite: 12 credits of sociology or permission of instructor.* Gardner

508 Individual and Social Organization *I or II, 3*
Sociology of the individual as the creator, preserver, and participant in society. Emphasis upon symbolic interaction in the growth of personal idiom, the development of social structure, and of the content of social change. *(Lec. 3) Prerequisite: permission of department.* Staff

510 Seminar in Deviance *I or II, 3*
Deviation from social expectations analyzed as a social phenomenon. Emphasis on deviation theories and research pertaining to individuals, subcultures, and social systems. Discussions, oral and written reports. *(Lec. 3) Prerequisite: permission of department.* Staff

512 Concepts of Social Structure *I or II, 3*
Examination of key spheres in social organization such as stratification, institutions, communities from a variety of perspectives including consensus and coercion models, pluralist versus elitist images of power structure, and the pros and cons of functionalism. *(Lec. 3) Prerequisite: permission of department.* Staff

571, 572 Seminars *I and II, 3 each*
Designed to cover areas of special research interests of graduate students not covered in other courses. *(Lec. 3) Prerequisite: permission of department.* Staff

595 Problems of Modernization in Developing Nations
See Economics 595.

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

SPANISH (SPA)

407 Intensive Practice in Conversation *I, 3*

408 Conversation and Teaching Materials *I, 3*

409 History of the Spanish Language *II, 3*

430 Castilian Literature of the Sixteenth and Seventeenth Centuries *II, 3*

450 Neo-Classicism and Romanticism *I, 3*

451 The Spanish Novel of the Nineteenth Century *I, 3*

461 The Generation of 1898 *I, 3*

462 Contemporary Spanish Literature *II, 3*

471, 472 Introduction to Hispanic-American Literature *I and II, 3 each*

481 Don Quijote *I, 3*

483 The Origins of the Novel in Spain *I, 3*

485 The Modern Spanish Novel *II, 3*

488 The Drama of the Golden Age *II, 3*

497, 498 Directed Study *I and II, 3 each*

511, 512 Castilian Literature from Its Origins through the Fifteenth Century *I and II, 3 each*
Castilian literature from its origins to the early period of the Renaissance with the reading and critical analysis of the works of outstanding representative authors encompassing all the genres of literary activity. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1971-72.* Navascués

573 Modern Hispanic-American Poetry *I, 3*
Hispanic-American poetry from the last two decades of the nineteenth century to the present day: a critical study with special attention to Martí, Darío, González Martínez, Gabriela Mistral, Ibarbourou and Neruda. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1971-72.* Bourquin

574 Hispanic-American Novel *II, 3*
Hispanic-American novel with particular emphasis on its trends in the twentieth century. The works of such writers as Isaacs, Cambaceres, Azuela, Arguedas, Gallegos, Mallea, Asturias and Fuentes will be analyzed. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1971-72.* Bourquin

582 Cervantes: Theater and Novels *II, 3*
The reading and critical interpretation of selections from *Comedias and Entreses, Las novelas ejemplares, La Galatea, Persiles y Sigismunda. (Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1972-73.* Hutton

583 The Spanish Baroque *I, 3*
Study and analysis of *Culteranismo* and *Conceptismo* in Gongora, Quevedo and Gracián. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1972-73.* Kossoff

584 Spanish Essay from the Eighteenth Century to the Present *II, 3*
Progression of Spanish intellectual and spiritual thought as seen in the writings of outstanding authors from the eighteenth century to the contemporary period. In particular the essayists: Feijóo, Cadalso, Jovellanos, Larra, Menendez y Pelayo, Giner de los Rios, Ganivet, Unamuno, Ortega y Gasset, Menendez Pidal and Américo Castro. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1972-73.* Hutton

591 Introduction to Research and Criticism *I, 3*
Introduction to scholarly research and literary criticism. Required as the first course for all candidates for the M.A. in Spanish. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Hutton

592 The Mystics and Mysticism *II, 3*
Significance of spiritual values in Spanish literature and, in particular, the phenomenon of mysticism and its literary productivity; critical study of the principal mystics and their works. *(Lec. 3) Prerequisite: graduate status or permission of instructor. In alternate years, next offered 1971-72.* Hutton

594 Seminar in Spanish Literature *I and II, 3*
Research and analysis of a particular author or problem of Spanish or Hispanic-American literature. *(Lec. 3) Prerequisite: graduate status or permission of instructor.* Staff

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

SPEECH (SPE)

400 Rhetoric *I, 3*

410 Semantics *II, 3*

491, 492 Special Problems *I and II, 1-3 each*

504 Speech and Hearing Research *I and II, 3*
Types of research in speech pathology, audiology, and communication science; critiques of representative models with special emphasis on experimental research; individual pilot projects or masters thesis.

(Lec. 3) Prerequisite: admission to graduate programs in speech. Beaupre, Doody, and Staff

551 Measurement of Hearing *I, 2-3*
History of hearing evaluation techniques; methods and practicum in basic audiological assessment; types of hearing losses and their implications for rehabilitation. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Staff

552 Advanced Measurement of Hearing *II, 2-3*
Speech audiometry; recruitment phenomena; functional hearing losses; education and rehabilitation problems associated with electronically assisted hearing. *(Lec. 2, Lab. 3) Prerequisite: SPE 551 or equivalent.* Staff

553 Pedoaudiology *I, 2-3*
Hearing evaluation problems associated with infants and preschool children; instrumentation and procedures; behavioral characteristics of hearing-impaired children. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Staff

554 Auditory Training and Speechreading *II, 2-3*
Rationale and techniques for auditory training programs; speechreading as a communication system; evaluation of methodologies for developing speechreading skills; practicum with children and adults. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Staff

555 Electronically Assisted Hearing *I, 2-3*
Principles of selective amplification and acoustical control; evaluation of various devices including wearable hearing aids; methods of instruction in the use of acoustical instruments. *(Lec. 2, Lab. 3) Prerequisite: SPE 551.* Staff

556 Automatic Audiometry *II, 2-3*
Bekesy principle; continuous, discrete, and pulsetone measurements; diagnostic implications of various type tracings; research findings and current issues; practicum. *(Lec. 2, Lab. 3) Prerequisite: SPE 552 and permission of department.* Staff

561 Disorders of Articulation *I, 2-3*
Types and causes of articulation disorders; rationale for case selection; S-R-L syndrome; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Staff

562 Disorders of Voice *I, 2-3*
Types and causes of voice disorders; rationale for case selection; medical implications; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Beaupre

563 Disorders of Rate and Rhythm *II, 2-3*
Types and causes of rate, rhythm and stress disorders; rationale for case selection; survey of stuttering theories, special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* FitzSimons

564 Disorders of Symbolization *II, 2-3*
Types and causes of language symbolization disorders; rationale for case selection; childhood aphasia and autism; special emphasis on rehabilitation procedures associated with individual involvements; practicum. *(Lec. 2, Lab. 3) Prerequisite: senior standing and SPE 260.* Staff

565 Diagnostic Procedures: Voice and Articulation *I, 2-3*
Instrumentation, tests, and procedures for evaluating individuals with voice and articulation disorders; practicum in speech and hearing centers; principles of differential diagnosis and report writing. *(Lec. 2, Lab. 3) Prerequisite: senior standing and permission of department.* Staff

566 Diagnostic Procedures: Rhythm and Symbolization *II, 2-3*
Instrumentation, tests, and procedures for evaluating individuals with disorders of rate, rhythm and symbolization; problems in differential diagnosis; practicum in speech and hearing centers. *(Lec. 2, Lab. 3) Prerequisite: senior standing and permission of department.* Staff

567, 568 Clinical Practicum in Speech and Hearing *I and II, 1-3 each*
Practice in diagnosis and therapy of disorders of speech and hearing. *(Lab. 2-6) Prerequisite: graduate status and permission of instructor.* Staff

571 Audiometric Screening and Surveying Techniques *I, 3*
Rationale, instrumentation, and techniques for selecting and administering group and individual screening tests; records and interpretations; current research and professional issues. *(Lec. 3) Prerequisite: admission to graduate program in audiology.* Staff

572 Medical Audiology *II, 3*
Diagnostic implications of audiometry for various organic disorders; supportive audiological information relevant to medical and surgical interventions; differential data associated with otosclerosis, Meniere's disease, VIIIth cranial nerve tumors, and malingering. *(Lec. 3) Prerequisite: admission to graduate program in audiology.* Staff

573 Contemporary Problems in Audiology *I, 3*
Critical review of current research and controversial issues within the profession; student selects one topic for independent study. *(Lec. 3) Prerequisite: admission to graduate program in audiology and permission of department.* Staff

574 Environmental Audiology *II, 3*
Hearing problems in industry, in the military, and

other high noise level environments; medico-legal aspects of hearing loss; hearing conservation programs in public schools. *(Lec. 3) Prerequisite: admission to graduate program in audiology and permission of department.* Staff

575 Speech and Language for Deaf or Hard of Hearing Child *I, 3*
The audiologist as hearing therapist in public school settings, medical clinics, and pre-school programs; responsibilities as part of the educational, psychological and medical team for active intervention with speech and language problems. *(Lec. 3) Prerequisite: admission to the graduate program in audiology and permission of department.* Staff

576 Speech and Language for Deaf or Hard of Hearing Adult *II, 3*
The audiologist as hearing therapist and consultant for adults with agenerative or degenerative hearing deficits; responsibilities as part of the rehabilitation team for active intervention with speech and language problems. *(Lec. 3) Prerequisite: admission to graduate program in audiology and permission of department.* Beaupre

581 Cerebral Palsy *I, 3*
Identification of types of cerebral palsy by location of lesion, motor symptomatology and additional handicaps; role of the speech clinician on the team; types of speech therapy with emphasis on the Bobath approach; current research and controversial issues. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* Staff

582 Stuttering and Cluttering *II, 3*
Analysis of the various etiological theories of stuttering and tachyphemia; techniques and implications of the several therapies; developing a rationale for intervention and case selection. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* FitzSimons

583 Cleft Palate and Other Orafacial Deformities *I, 3*
Relationship of prosthetic, surgical, and orthodontic intervention to speech rehabilitation; role of speech clinician on the cleft palate team; assessment of therapeutic approaches; current research and controversial issues. *(Lec. 3) Prerequisite: admission to the graduate program in speech pathology and permission of department.* Staff

584 Delayed Speech and Language *II, 3*
Problems in differential diagnosis for deafness, aphasia, autism, and learning disorders; demonstrations and critiques of clinical interventions with children who have speech and language learning deficits including dyslexia and acalculia. *(Lec. 3) Prerequisite: admission to the graduate program in speech pathology.* FitzSimons

585 Aphasia and Allied Language Disorders *I, 3*
Types of adult aphasia; central and peripheral dysarthrias; role of speech clinician on the rehabilitation team; other degenerative disorders such as Parkinsonism and dystonia; current research and controversial issues. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology and permission of department.* Staff

586 Alaryngeal Speech *II, 3*
Voice and speech rehabilitation for individual without a functional larynx; social, emotional and medical considerations; clinical procedures for esophageal, pharyngeal and buccal speech; implications for use of artificial larynx; current research. *(Lec. 3) Prerequisite: admission to graduate program in speech pathology.* Beaupre

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

STATISTICS

Business Statistics (Organizational Management and Industrial Relations)
501, 502 Design and Analysis of Experiments
981 Fundamental Business Statistics

Experimental Statistics (Computer Science and Experimental Statistics)
411 Statistical Methods in Research I
412 Statistical Methods in Research II
500 Nonparametric Statistical Methods
511 Linear Statistical Models
520 Fundamentals of Sampling and Applications
532 (or ASC 532) Experimental Design
541 Multivariate Statistical Methods
576 (or ECN 576, REN 576) Econometrics I
577 (or ECN 577, REN 577) Econometrics II
591, 592 Problems in Experimental Statistics
610 (or PSY 610) Factor Analysis
635 (or IDE 635) Response Surfaces and Evolutionary Operations

Industrial Engineering
411 Engineering Statistics I
412 Engineering Statistics II
633 Advanced Statistical Methods for Research and Industry
634 Design and Analysis of Industrial Experiments
635 (or EST 635) Response Surfaces and Evolutionary Operations

Mathematics
451 Introduction to Probability and Statistics
452 Mathematics Statistics
456 Probability
550 Advanced Probability
551 Advanced Mathematical Statistics I
552 Advanced Mathematical Statistics II

Psychology
410 Quantitative Methods in Psychology II
510 Intermediate Quantitative Methods in Psychology
610 (or EST 610) Factor Analysis

TEXTILES AND CLOTHING (TXC)

403 Advanced Textiles *I and II, 3*

405 Advanced Clothing *I and II, 3*

406 (HMG 345) Housing Planning *I, 3*

424 Seminar in Textiles and Clothing *I and II, 3*

433 Textiles and Clothing Industry *I and II, 3*

440 Historic Textiles *I, 3*

502 Seminar in Textiles and Clothing *I and II, 3*
Original investigations in the area of clothing problem. *(Lec. 3)* Carpenter

533 Textile and Clothing Economics *I and II, 3*
The economic development of production and distribution of textiles and clothing. *(Lec. 3)* Staff

540 Special Problems in Textiles and Clothing *I and II, 3*
Supervised independent study in specific areas of textiles and clothing. Staff

550 Seminar and Practicum *I and II, 3*
Professional role of the textiles and clothing specialist. *Prerequisite: permission of department.* Staff

560 Special Problems in Textiles and Clothing *I and II, 3*
Supervised independent study in specific areas of textiles and clothing. Staff

570 Seminar in Textiles and Clothing Research *I and II, 3*
Critical study of research literature and research techniques. *Prerequisite: permission of department.* Staff

580 Research Methods in Textiles and Clothing *I and II, 3*
Development and execution of research in textiles and clothing following the historical, descriptive, and experimental methods. Analysis of current research in the field. *(Lec. 2, Lab. 2)* Carpenter

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

THEATRE (THE)

400 Individual Problems in Theatre Studies *I and II, 1-3*

401 Special Group Studies *I and II, 1-3*

410 Advanced Acting *I and II, 1-3*

420 Advanced Directing Practice *I and II, 1-3*

440 Advanced Stage Management *I and II, 1-3*

450 Advanced Costuming *I and II, 1-3*

451 Stage Costume Technology *I, 2*

460 Advanced Scene Design *I and II, 1-3*

470 Advanced Stage Lighting *I and II, 1-3*

481 American Theatre History *I, 3*

482 Contemporary Theatre *I, 3*

ZOOLOGY (ZOO)

418 Experimental Embryology *II, 3*

421 Principles of Taxonomy *I, 3*

441 General (Cellular) Physiology *I, 3*

442 Mammalian Physiology *II, 3*

463 Animal Ecology *II, 3*

465 Limnology *I, 3*

466 Vertebrate Biology *II, 3*

467 Animal Behavior *II, 3*

468 Mammalogy *II, 3*

471 Evolution *I, 3*

473 History of Biology *I, 3*

477 Human Genetics *I, 3*

482 Systematic Entomology *I, 3*

484 (or ELE 484) Modeling of Physiological Systems *II, 3*

512 Fine Structure of the Animal Cell *II, 4*
Experimental evidence correlating the fine structure and function of cell organelles, including especially the plasma membrane, endoplasmic reticulum, mitochondria, ribosomes, centrioles, lysosomes and cilia. Introduction to instrumental and to cytochemical methods for study of each cell. Emphasis on the examination of electron micrographs. *(Lec. 3, Lab. 3) Prerequisite: ZOO 210 or permission of department. In alternate years, next offered 1972-73.* Goertemiller

531 Advanced Parasitology Seminar *I, 2*
Advanced topics in the host-parasite relationships of protozoan and metazoan parasites. Reading knowledge of one foreign language assumed. Topics vary from year to year. Ecology of the Helminth Fauna of Fishes Inhabiting New England Coastal Waters in 1971-72. *(Lec. 2) Prerequisite: ZOO 331 or equivalent. In alternate years, next offered 1971-72.* Hyland and Zinn

543 Biology of Reproduction in Animals *I, 3*
Aspects of reproduction in animals of different phyla. Hormonal interrelationships, environmental control and adaptive mechanisms. *(Lec. 2, Lab. 3) Prerequisite: ZOO 345 and 545. In alternate years, next offered 1972-73.* Chipman

544 Invertebrate Physiology *II, 3*
Life processes of invertebrate animals, including nutrition, metabolism, nitrogen excretion, respiratory pigments, mechanisms of locomotion, hormonal effects. *(Lec. 2, Lab. 2) Prerequisite: ZOO 354 and 441 or their equivalents.* Hammen

545 Endocrinology *I, 3*
Comparative anatomy, histology, embryology, physiology of the endocrine glands of vertebrates. Lectures, demonstrations, student reports. *(Lec. 3) Prerequisite: ZOO 216 and 313 or equivalent.* LaRoche

547 Comparative Physiology *I, 3*
Diverse adaptations by which animals of the different phyla meet the common problems of life processes. Emphasis on an evolutionary consideration of receptors, nervous systems, and effectors. Laboratory experiments on favorable invertebrate and lower vertebrate preparations. *(Lec. 2, Lab. 3) Prerequisite: ZOO 345.* Hill

548 Neurophysiology *II, 4*
Fundamental processes occurring in the nervous systems of invertebrates and vertebrates. Structure and functions of nervous elements with emphasis on integration and coordination of motor mechanisms. *(Lec. 3, Lab. 3) Prerequisite: ZOO 345, MTH 141 or equivalent, and permission of instructor. In alternate years, next offered 1972-73.* Staff

552 Pathology of Endocrine Functions *II, 3*
The anatomical, physiological, developmental and behavioral changes associated with disorders of hormone production in vertebrates, primarily in mammals. *(Lec. 3) Prerequisite: ZOO 545 or permission of instructor.* LaRoche

554 Seminar in Morphogenetic Theory *II, 2*
Recent investigations in developmental physiology, and the control of differentiation and development. Reference to original papers. *(Lec. 2) Prerequisite: ZOO 313 or equivalent, and permission of instructor. In alternate years with ZOO 418, next offered 1971-72.* Goertemiller

555 Seminar in Physiological Genetics *I, 3*
Consideration of the nature of the gene and its action in the development and physiological processes of the organism. *(Lec. 3) Prerequisite: BOT 352 or equivalent, basic knowledge of chemistry and biology, and permission of instructor. In alternate years, next offered 1971-72.* Crenshaw

562 Seminar in Behavioral Ecology *I, 1*
Special topics in the relationships between animal behavior and ecology, such as social organization of animals, evolution of behavior, competition and habitat selection. Discussion and presentation of individual reports. *(Lec. 1)* Staff

563 Ichthyology *I, 3*
Fishes of the world. Their structure, evolution, classification, ecology and physiology. Emphasis on local marine and freshwater fauna. Several field trips. *(Lec. 2, Lab. 3) Prerequisite: ZOO 216 and 466.* Krueger

576 Ecological Genetics *II, 4*
Analysis of the interactions between genotype and environment in natural and laboratory populations of animals, including selection and other mechanisms responsible for gene frequency change, the evolution of dominance, heterosis and speciation. *(Lec. 3, Lab. 3) Prerequisite: BOT 352 or permission of department.* Crenshaw

579 (or BOT 579 or GEN 579) Advanced Genetics Seminar *I and II, 1*
Current topics in genetics, including cytological, ecological, molecular, physiological, population, quantitative and radiation genetics. *(Lec. 1) Prerequisite: GEN 352 and permission of instructor.* Crenshaw and Mottinger

581 General Acarology *I, 3*
Detailed study of mites and ticks, their structure, life histories, and classification. Free-living forms as well as plant and animal feeders. *(Lab. 6) Prerequisite: ZOO 331 or 481 or 586, and permission of instructor. In alternate years, next offered 1971-72.* Hyland

586 Medical and Veterinary Entomology *II, 3*
Life histories, classifications, habits and control of insects and other arthropods which affect the health of man and animals. Duties of the entomologist on public health team, including field practice in methods of insect surveys, control measures and subsequent surveys to determine success of control measures. *(Lec. 1, Lab. 4) Prerequisite: ZOO 331 or 481 or equivalent. In alternate years, next offered 1971-72.* Hyland

595, 596 Graduate Seminar in Zoology *I and II, 1 each*
Consideration of philosophy and techniques of research and information presentation at the graduate level consisting of reports by students, critique and discussion by the class. *Required of entering graduate students in zoology. Prerequisite: graduate standing. S/U credit.* Chipman

599 Masters Thesis Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

640 to 645 Seminar in Physiology *I and II, 1-3 each*
Reports and discussions on topics of current research in physiology. Subject matter adapted to meet interests of staff and students. *(Lec. 1-3) Prerequisite: ZOO 345.* Hill and Staff

648, 649 Seminar in Environmental Physiology *I and II, 2 each*
Reading, library research, special lectures on topics of current research interest in environmental physiology. *(Lec. 2) Prerequisite: one year of physiology, and at least one course in ecology or permission of department.* Staff

664 Seminar in Ichthyology *II, 2*
Reading, library research, reports and class discussion on problems of current research interest in the biology of fishes. *(Lec. 2) Prerequisite: ZOO 563 or permission of department.* Krueger

666 Physiological Ecology *II, 3*
Comparative study of physiological adjustments which animals make in response to environmental factors, with emphasis on the physiological basis of animal distribution and evolution. *(Lec. 3) Prerequisite: one year of physiology and a course in ecology.* Staff

668 Laboratory in Physiological Ecology *II, 3*
Application of laboratory techniques to research problems in physiological ecology, such as energetics, gas exchange, thermoregulation and temperature tolerance, salt and water balance, and acclimatization to various environmental factors. Assigned research project on advanced level. *(Lab. 9) Prerequisite: ZOO 666 (may be taken concurrently with ZOO 666), and permission of department.* Staff

670 to 675 Advanced Ecology Seminars *I and II, 2 each*
Specialized and advanced areas of ecological research and theory, including zoogeography, pleistocene ecology, population dynamics, energy flow in ecosystems and radiation ecology. *Prerequisite: ZOO 463 and permission of department.* Shoop and Staff

691, 692 Assigned Work *I and II, 1-3 each*
Subject matter adapted to meet needs of student. May be arranged with any member of the staff, with the permission of the head of the department. *(Lec. 3 or Lab. 6)* Staff

693, 694 Zoological Problems *I and II, 1-3 each*
Special work to meet needs of individual students who are prepared to undertake special problems. *(Lec. 3 or Lab. 6)* Staff

699 Doctoral Dissertation Research *I and II*
Number of credits is determined each semester in consultation with the major professor or program committee.

Graduate School Calendar

FALL SEMESTER 1971

September 13, 14, Monday, Tuesday
Graduate registration, 9:00 a.m. to 5:00 p.m., Keaney Gymnasium. Bills and fees must be paid at the time of registration.

September 15, Wednesday
Classes begin, 8:00 a.m.
Due date in Princeton, N.J., for registration forms for October 9 ETS language examinations.

September 29, Wednesday
Final date for adding courses or for changing from audit to credit.
Final date for February master's degree candidates to submit thesis proposals.

October 9, Saturday
ETS language examinations in French, German, Russian and Spanish.

October 11, Monday
Holiday, Columbus Day.

October 25, Monday
Holiday, Veterans Day.

November 4, Thursday
Final date for June doctoral degree candidates to submit dissertation proposals.

November 6, Saturday
Mid-semester.
Final date for dropping courses without failure or for changing from credit to audit.

November 15 to 19
Graduate registration for 1972 spring semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

November 24, Wednesday
Thanksgiving recess begins, 12:50 p.m.

November 29, Monday
Thanksgiving recess ends, 8:00 a.m.

December 18, Saturday
Christmas recess begins, 12:50 p.m.

January 3, Monday
Christmas recess ends, 8:00 a.m.
Final date for all February degree candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extensions of time will be granted.*

January 7, Friday
Last day of classes.

January 11 to 19
Final examinations.

January 12, Wednesday
Due date in Princeton, N.J., for registration forms for February 5 ETS language examinations.

January 28, Friday
Final date for June master's degree candidates to submit thesis proposals.
Final date for students admitted in September 1971 to submit programs of study.

SPRING SEMESTER 1972

January 31, February 1, Monday, Tuesday
Graduate registration, 9:00 a.m. to 4:00 p.m., Memorial Union. Bills and fees must be paid at the time of registration.

February 2, Wednesday
Classes begin, 8:00 a.m.

February 5, Saturday
ETS language examinations in French, German, Russian and Spanish.

February 16, Wednesday
Final date for adding courses or for changing from audit to credit.

March 17, Friday
Final date for October doctoral degree candidates to submit dissertation proposals.

March 22, Wednesday
Due date in Princeton, N.J., for registration forms for April 15 ETS language examinations.

March 24, Friday
Mid-semester.
Final date for dropping courses without failure or for changing from credit to audit.
Spring recess begins, 5:00 p.m.

April 3, Monday
Spring recess ends, 8:00 a.m.

April 15, Saturday
ETS language examinations in French, German, Russian and Spanish.

April 24 to 28
Graduate registration for 1972 fall semester, 9:00 a.m. to 4:00 p.m., Registrar's Office.

May 4, Thursday
Final date for all June degree candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extensions of time will be granted.*

May 15 to June 1
Oral defense of thesis and dissertation examinations for June degree candidates.

May 18, Thursday
Last day of classes.

May 22 to 31
Final examinations.

May 29, Monday
Holiday, Memorial Day.

June 1, Thursday
Final date for all June degree candidates to submit in final form master's theses and doctoral dissertations, which have been successfully defended.
Final date for October master's degree candidates to submit thesis proposals.
Final date for February doctoral degree candidates to submit dissertation proposals.

June 2, Friday
Last day for grades, 9:00 a.m.

June 11, Sunday
Commencement.

SUMMER SESSION 1972

June 19, Monday
First five-week term begins.

June 26, Monday
Six-week term begins.

June 28, Wednesday
Due date in Princeton, N.J., for registration forms for July 22 ETS language examinations.

July 4, Tuesday
Holiday, Independence Day.

July 22, Saturday
First five-week term ends.
ETS language examinations in French, German, Russian and Spanish.

July 24, Monday
Second five-week term begins.

August 5, Saturday
Six-week term ends.

August 11, Friday
Final date for all October degree candidates to submit completed master's theses and doctoral dissertations in a form acceptable for examination purposes. *No extensions of time will be granted.*

August 14, Monday
Holiday, Victory Day.

August 26, Saturday
Second five-week term ends.

Note: oral defense examinations may be scheduled and conducted at any time during the fall and spring semesters. The examinations will be scheduled no sooner than ten days after delivery to the Graduate School Office of four copies of a thesis or dissertation acceptable for examination purposes. During Summer Session, special arrangements must be made with both the Graduate School Office and the department for scheduling oral defense examinations. Such examinations will be scheduled *only* at the convenience of participating faculty. Examinations *will not* be scheduled during recess periods (intersessions, Christmas and spring recesses).

Academic and Service Buildings

1 Administration Building C3
2 Athletic Bubble D1
3 Ballentine Hall *business administration* B3
4 Biological Science Building A3
5 Bliss Hall *engineering* B4
6 Canterbury House *Episcopalian center* E3
7 Catholic Center B4
8 Chafee Social Science Center A3
9 Child Development Center E3
10 Crawford Hall *chemical engineering* B4
11 Dairy Barn B2
12 Davis Hall C3
13 East Hall *physics* B4
14 Edwards Hall C4
15 Faculty Center B4
16 Fine Arts Center A4
17 Fire Station B5
18 Fogarty Health Science Building *nursing and pharmacy* D3
19 Gilbreth Hall *industrial engineering* B4
20 Green Hall D4
21 Greenhouses A4
22 Home Management House E3
23 Independence Hall *arts and sciences* D4
24 Information D3
25 Keaney Gymnasium D1
26 Kelley Hall *electrical engineering* B4
27 Library B3
28 Lippitt Hall B3

Lower College Road Buildings

29 No. 34 Psychology *graduate training* D3
30 No. 37 Graduate Reading Center D3
24 No. 44 Police Department, Psychology D3
31 No. 70 Career Planning and Placement, Economics C3
32 No. 74 Graduate Library School C3
33 No. 80 Personnel, Purchasing C3
34 Memorial Union D3
35 Morrill Science Building *life sciences* D3
108 Community Planning Studios D5
36 Pastore Chemical Laboratory D3
37 Planetarium B4
38 Potter Building C2
39 Quinn Hall *home economics* C3
40 Ranger Hall *biological sciences* C4
41 Rodman Hall B3
83 Roosevelt Hall C3
42 Sherman Building *maintenance* B1
43 Student Center, Afro-American B3
44 Taft Hall B3
45 Tootell Physical Education Center C1
46 Tyler Hall *mathematics and computer laboratory* A4

Upper College Road Buildings

47 No. 19 Oceanography E4
48 No. 31 Psychology *research* D4
49 No. 36 Community Planning D4
50 No. 85 Gerontology C4
51 No. 95 Social Sciences C4
52 Wales Hall *mechanical engineering* B4
53 Washburn Hall *arts and sciences* C4
54 Watson House B3
55 Woodward Hall *resource development* B3

Other Locations

56 Beck Field D1
57 Experimental Turf Plots A1
58 Horticulture Gardens A4
59 Meade Field B2
60 Tennis Courts A3, E1
61 Water Tower B4

Residence and Dining Halls

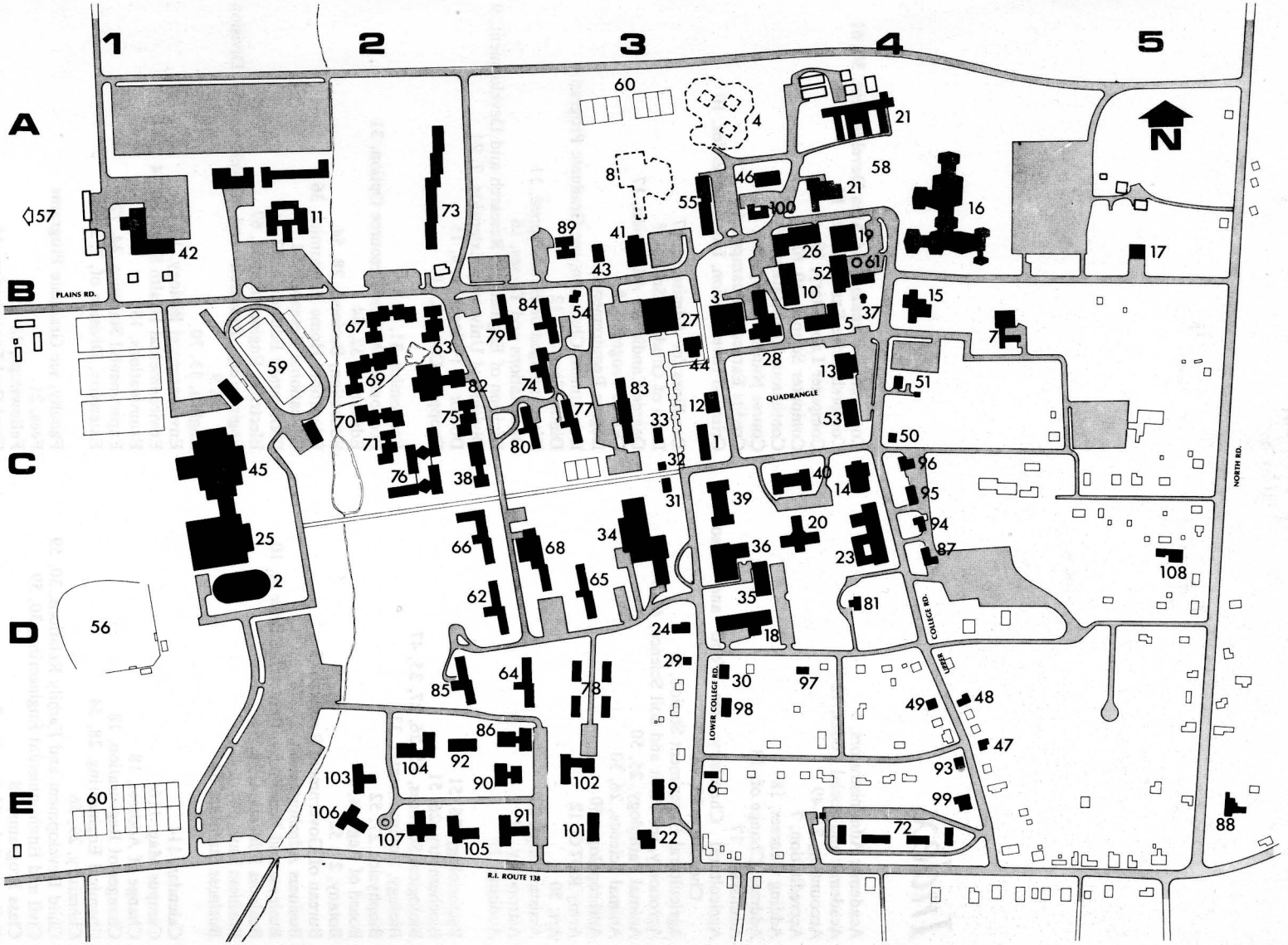
62 Adams Hall D2
63 Aldrich Hall B2
64 Barlow Hall D2
65 Bressler Hall D3
66 Browning Hall D2
67 Burnside Hall B2
68 Butterfield Hall *residence and dining* D3
69 Coddington Hall B2
70 Dorr Hall C2
71 Ellery Hall C2
72 Faculty Apartments E4
73 Heathman Hall A2
74 Hope Hall *dining* B3
75 Hopkins Hall C2
76 Housing 1970 C2
77 Hutchinson Hall C3
78 Married Student Apartments D3
79 Merrow Hall B2
80 Peck Hall B3
81 President's House D4
82 Roger Williams Commons *housing office and dining* C2
84 Tucker Hall B3
85 Weldin Hall D2

Fraternities

86 Alpha Epsilon Pi E2
87 Chi Phi D4
88 Lambda Chi Alpha E5
89 Phi Gamma Delta B3
90 Phi Kappa Psi E2
91 Phi Mu Delta E2
92 Phi Sigma Delta E2
93 Phi Sigma Kappa E4
94 Sigma Alpha Epsilon D4
95 Sigma Chi C4
96 Sigma Nu C4
97 Tau Epsilon Phi D4
98 Tau Kappa Epsilon D3
99 Theta Chi E4
100 Theta Delta Chi B3

Sororities

101 Alpha Chi Omega E3
102 Alpha Delta Pi E3
103 Alpha Xi Delta E2
104 Chi Omega E2
105 Delta Zeta E2
106 Sigma Delta Tau E2
107 Sigma Kappa E2


1
2
3
4
5
A
B
C
D
E
N
PLAINS RD.
QUADRANGLE
LOWER COLLEGE RD.
UPPER COLLEGE RD.
NORTH RD.
R.I. ROUTE 138
57
42
11
73
60
4
21
8
55
46
58
100
16
89
41
43
26
19
61
52
10
37
17
15
3
5
27
54
84
79
67
63
59
69
82
74
83
44
28
13
7
51
70
75
77
33
12
53
50
71
80
1
32
45
76
38
31
39
40
14
96
95
94
87
108
25
66
68
34
20
36
23
2
65
62
35
18
181
56
24
29
64
78
85
30
97
98
49
48
47
86
92
104
90
102
9
93
99
103
106
107
105
91
101
22
72
88
60

Index

Academic Administrators, 5
Academic and Social Codes, 12
Accounting, 25, 49
Accreditation, 7
Adding Courses, 18
Address, Change of, 18
Admission, 17
Agricultural Chemistry, see Food and Resource Chemistry, 35, 74
Agricultural Experiment Station, 9
Agronomy, see Plant and Soil Science, 44, 100
Animal Pathology, 25, 50
Animal Science, 26, 50
Anthropology, 50
Army ROTC, 12
Art, 50
Assistantships, 23
Astronomy, 51
Auditing, 19

Bacteriology, 26, 51
Biochemistry, 26, 51
Biological Sciences, 25, 26, 27, 35, 47
Biology, Environmental, 33
Biophysics, 27, 52
Board of Regents, 5
Botany, 27, 52
Bureau of Government Research, 9
Business Administration, 27, 76
Business and Economics, Research Center in, 10
Business Education, 28, 54
Business Law, 54
Business Statistics, 54

Calendar, 114
Campus Map, 116
Change of Address, 18
Changes of Registration, 18
Chemical Engineering, 28, 54
Chemistry, 29, 56
Child Development and Family Relations, 30, 59
Civil and Environmental Engineering, 30, 59
Class Programs, 18
Colleges of the University, 7
Community Planning and Area Development, 30, 61
Comprehensive Examination, 15
Computer Laboratory, 10
Computer Science, 30, 62
Continuous Registration, 19
Course Numbering System, 13, 49
Credits Earned Off-campus, 19
Criminal Investigation, Laboratories for, 10

Deadlines for Admission, 17
Dean of Graduate School, 5
Degree Candidates Admission, 17
Degree Programs, 8
Degree Requirements, 13
Department Chairmen, see Graduate Programs
Dining Services, 12
Disadvantaged or Handicapped, 11
Dissertations and Theses, 16
Division of Engineering Research and Development, 9
Division of University Extension, 7, 21
Doctor of Philosophy, 8, 15
Dropping Courses, 18

Economics, 31, 63
Economics, Marine Resource Option, 31
Education, 32, 64
Education, Business, 28, 54
Education, Home Economics, 36
Educational Research, 32
Elementary Education, 32
Electrical Engineering, 32, 67
Engineering Research and Development, Division of, 9
English, 33, 70
Environmental Biology, 10, 33
Environmental Health Sciences, 34
Examinations, 15
Experimental Statistics, 34, 72
Extension, Division of, 7, 21

Faculty, see Graduate Programs
Fees, 21
Fellowships, 22
Final Oral Examination, 15

Finance, 34, 73
Financial Aid, 22
Food and Nutritional Science, 34, 73
Food and Resource Chemistry, 35, 74
Food and Resource Economics, see Resource Economics, 45, 106
Food Services, 74
Foreign Applicants, 17
Forest and Wildlife Management, 74
French, 35, 74
Full-time and Part-time Students, 19

General Business Administration, 76
Genetics, 76
Geography, 35, 76
Geology, 36, 77
German, 78
Government Research, Bureau of, 9
Grades, 14
Graduate Assistantships, 23
Graduate Council, 5
Graduate Degree Programs, 8
Graduate Library School, 9
Graduate Life, 11
Graduate School of Oceanography, 9
Graduate Student Association, 11
Graduate Study, 7
Guidance, 32

Health Sciences, Environmental, 34
History, 36, 78
Home Economics Education, 36
Home Management, 80
Horticulture, see Plant and Soil Science, 44, 100
Housing, 12

Industrial Engineering, 37, 80
Institute of Environmental Biology, 10, 33
Intellectual Opportunity Plan, 19
International Center for Marine Resource Development, 10
International Development Studies, Graduate Certificate Program, 37
International Studies, 37
International Relations Specialization in Political Science, 37
Interstate Cooperation Program, 8, 21
Italian, 82

Jones Campus, 7
Journalism, 82

Laboratories for Scientific Criminal Investigation, 10
Language, 15, 16
Latin, 82
Law of the Sea Institute, 10
Library School, 9
Library Science, 38, 82
Library, The University, 10
Linguistics, 84
Living Accommodations, 12
Loans, 23

Management, see Organizational Management and Industrial Relations, 94
Management Science, 84
Map, 116
Marine Affairs, 38, 84
Marine Research Programs, 10
Marine Resources Option in Economics, 31
Marketing Management, 84
Master's Degree Requirements, 14
Mathematics, 39, 85
Mechanical Engineering and Applied Mechanics, 39, 86
Medicinal Chemistry, 40, 88
Music, 89

Narragansett Bay Campus, 7
New England Board of Higher Education, 8, 21
Non-degree Student Admission, 18
Non-thesis Option, 14
North Atlantic Regional Studies, 38
Nuclear Science Center, 11
Nuclear Engineering, 40, 89
Nursing, 40, 90

Ocean Engineering, 41, 90

Oceanography, 9, 41, 92
Off-campus Activity, 19
Oral Examination, 15
Organizational Management and Industrial Relations, 94

Part-time Students, 19
Pass/Fail Option, 19
Payment of Fees, 18
Personnel, 5
Pharmaceutical Chemistry, see Medicinal Chemistry, 40, 88
Pharmaceutical Sciences, 40, 42
Pharmacognosy, 42, 94
Pharmacology and Toxicology, 42, 95
Pharmacy, 42, 96
Pharmacy Administration, 43, 96
Philosophy, 43, 97
Physical Education, 43, 98
Physics, 43, 99
Plant and Soil Science, 44, 100
Plant Pathology-Entomology, 44, 101
Political Science, 44, 101
Portuguese, 103
Professional Degrees, 8, 15
Program of Studies, 13
Psychology, 45, 103
Public Administration, 44

Qualifying Examination, 15
Quantitative Business Administration, see Management Science, 84

Reading, 32
Refunds, 22
Regents, Board of, 5
Regional Programs, 8, 21
Registration, 18
Remission of Fees, 22
Requirements for Degrees, 13
Research, 9
Research Center in Business and Economics, 10
Research Resources, 10
Research Tool, 16
Reserve Officers Training Corps, 12
Resource Economics, 45, 106
Responsibility, 13
Rhode Island Water Resources Center, 10
Russian, 107

Schedule of Fees, 21
Scholarships, 23
Scholastic Standing, 14
Science Education, 32
Sea Grant College Program, 10
Secondary Education, 32
Services, 11
Social and Academic Codes, 12
Sociology, 46, 107
Spanish, 46, 108
Speech, 108
Speech Pathology and Audiology, 46
Statistics, 110
Student Association, Graduate, 11
Summer Session, 18, 21

Textiles, Clothing and Related Art, 47, 111
Theatre, 111
Theses and Dissertations, 16
Thesis Option, 14
Transfer Credit, 17
Trident, 11
Tuition Scholarships, 23

Vessels, 11
Veterans' Benefits, 23

Water Resources Center, 10

Youth, Adult and Community Education, 32

Zoology, 47, 111